Medical Extracts

VOL-1

1799

TO

THE RIGHT HONOURABLE

SIR JOSEPH BANKS, BARONET, K. B.

PRESIDENT OF THE ROYAL SOCIETY, &c. &c. &c.

SIR,

AS patron of the liberal ſciences, and more eſpecially from the native benevolence of your diſpoſition, as the favourer of every attempt that may tend to confirm the health, and remove the afflictions of mankind, this Work is humbly preſented to your notice.

It is preſumed, that it will be found amuſing to the philoſopher, who conſiders the human frame as a part, and certainly not the leaſt intereſting part, of natural hiſtory.

It places man in the centre, and ſhews his relationſhip to the ſeveral objects which ſurround him.

In the FIRST VOLUME, is difplayed the progrefs of medicine and chemiftry; and the relationfhip we ftand in to the air we breathe.

The SECOND VOLUME difclofes our relationfhip to light, heat, food, exercife, and all the variety of mental emotion.

Thefe *two volumes* include the hiftory of *direct ftimuli**, being an explanation of the Firft Law of the Animal Œconomy, "*that health is maintained by a due proportion of ftimuli,*" with the hiftory of *thofe difeafes arifing from the fuperabundance of natural ftimuli*, and *the proper method of cure*.

The THIRD VOLUME embraces the confideration of *indirect ftimuli**, as impure air, darknefs, cold, hunger, reft, and the different fedative paffions of the mind, which are no otherways ftimuli than as they relate to the Second Law, "*that an accumulation of irritability enfues from a deficiency of direct ftimuli*;" and this Volume *embraces the difeafes of afthenia*, or weaknefs.

* Vide the Definition of this term, page 257.

The

The FOURTH VOLUME is employed in the consideration of the Third Law, " *that the excessive action of stimuli exhausts the irritable principle in the blood*;" and here the action of *different poisons* is fully considered, with the *methodus medendi*, or *antidote*.

The FIFTH VOLUME is a continuation of the *same subject*, shewing more particularly the rise and progress of *Pneumatic Medicine*.

Thus have we attempted to set forth the Brunonian System, as improved by the latest discoveries in chemistry and medicine; and, perhaps, we shall be said to have aimed at the establishment of a *New System* of physiology and medicine, which hath arisen out of the old, like the phœnix from the ashes of its parent, carrying on its wings the means of preserving health, and warding off disease; a system not to be considered in itself as perfect, but only as the foundation of a better structure, which future industry may erect, and which may not moulder, like other fabricks, into the sand of which they were composed, but as being founded upon *facts*, and *reasonings drawn from them*, may

stand

ſtand unimpaired, like the Newtonian Philoſophy, a rock amidſt the waſte of ages.

Wiſhing you, Sir, the enjoyment of a long life, devoted even from the earlieſt period to the ſervice of your country, and the cauſe of ſcience.

I have the honour to ſubſcribe myſelf,

SIR,

With the greateſt reſpect and eſteem,

Your faithful, obliged,

And obedient Servant,

&c. &c.

LONDON,
May 1, 1760.

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THE

PROGRESS

OF

MEDICINE.

Viresque acquirit eundo.

VIRG.

SECTION I.

HIPPOCRATES, who is supposed to have lived 400 years before the birth of Christ, is the most ancient author whose writings expressly on the subject of the medical art are preserved; and he is therefore justly considered as the father of physic. All the accounts which we have prior to this time, if not evidently fabulous, are at the utmost highly conjectural. Even the medical knowledge of Pythagoras, so much celebrated as a philosopher, can hardly be considered as resting on any other foundation. But from the time of Hippocrates, medicine, separated from philosophy and religion, seems to have assumed the form of a science, and to have been practised as a profession. It may not, therefore, be improper to Hippocrates

to give a particular account of the ſtate of medical knowledge as tranſmitted to us in his writings. The writings attributed to Hippocrates, it may be remarked, are not probably all his. Nor is it wonderful that attempts ſhould have been made to increaſe the value of manuſcripts, by attributing them to a name of ſuch eminence. But although what are tranſmitted to us under the title of his works may have been written by different hands, yet the preſumption is, that moſt, if not all of them, are of nearly as early a date, and contain the prevailing opinions of thoſe times.

His writings.

Birth.

According to the moſt authentic accounts, Hippocrates was a native of the iſland of Cos, and born in the beginning of the 80th Olympiad. In the writings tranſmitted to us as his, we find a general principle adopted, to which he gives the name of Nature. To this principle he aſcribes a mighty power. "Nature," ſays he, "is of itſelf ſufficient to every animal." Upon this footing, as if Nature had been a principle endowed with ſenſe, he gives her the title of wiſe; and aſcribes virtues or powers to her, which are her ſervants, and by means of which ſhe performs all her operations in the bodies of animals: and diſtributes the blood, ſpirits, and heat, through all parts of the body, which by theſe means receive life and ſenſation. And in other places he tells us, that it is this faculty

His idea of Nature.

which

which gives nourishment, preservation, and growth, to all things.

The manner in which Nature acts, or commands her subservient powers to act, is by attracting what is good and agreeable to each species, and by retaining, preparing, and changing it; and on the other side in rejecting whatever is superfluous or hurtful, after she has separated it from the good. This is the foundation of the doctrine of depuration, concoction, and crisis in fevers, so much insisted upon by Hippocrates, and many other physicians.

Of the causes of diseases. As far as he attempts to explain the causes of disease, he refers much to the humours of the body, particularly to the blood and the bile. He treats also of the effects of sleep, watchings, exercise, and rest, and all the benefit or mischief we may receive from them. Of all the causes of diseases, however, mentioned by Hippocrates, the most general are *diet* and *air*. On the subject of diet he has composed several books, and in the choice of this he was exactly careful; and the more so, as his practice turned almost wholly upon it. He also considered the air very much; he examined what winds blew ordinarily or extraordinarily; he considered the irregularity of the seasons, the rising and setting of stars, or the time of certain constellations; also the time of the solstices and of the equinoxes; those days,

in his opinion, producing great alterations in certain distempers.

He does not, however, pretend to explain how from these causes, that variety of distempers arises which is daily to be observed. All that can be gathered from him with regard to this is, that the different causes above mentioned, when applied to the different parts of the body, produce a great variety of distempers. Some of these distempers he accounted mortal, others dangerous, and the rest easily curable, according to the cause from whence they spring, and the parts on which they fall. In several places also he distinguishes diseases from the time of their duration, into acute or short, and chronical or long. He likewise distinguishes diseases by the particular places where they prevail, whether ordinary or extraordinary. The first, that is, those that are frequent and familiar to certain places, he called endemic diseases; and the latter, which ravaged extraordinarily sometimes in one place, sometimes in another, which seized great numbers at certain times, he called epidemic diseases; and of this kind the most terrible is the plague. He likewise mentions a third kind, the opposite of the former; and these he calls sporadic, or straggling diseases: these last include all the different sorts of distempers which invade at any one season, which are sometimes of one

His division of diseases.

fort, and sometimes of another. He distinguished between those diseases which are hereditary, or born with us, and those which are contracted afterwards; and likewise between those of a kindly and such as are of a malignant nature, the former of which are easily and frequently cured, but the latter give the physicians a great deal of trouble, and are seldom overcome by all their care.

Hippocrates remarked four stages in distempers; viz. the *beginning* of the disease, its *augmentation*, its *height*, and its *declination*. In such diseases as terminate fatally, death comes in place of the declination. In the third stage, therefore, the change is most considerable, as it determines the fate of the sick person, and this is most commonly done by means of a *crisis*. By this word he understood any sudden change in sickness, whether for the better or for the worse, whether health or death succeed immediately. Such a change, he says, is made at that time by Nature, either absolving or condemning the patient. Hence we may conclude that Hippocrates imagined diseases to be only a disturbance of the animal economy, with which Nature was perpetually at variance, and using her utmost endeavours to expel the offending cause. Her manner of acting on these occasions is to reduce to their natural state those humours whose discord occasions the disturbances of the whole

 body,

body, whether in relation to their quantity, qua-
lity, mixture, motion, or any other way in which
they become offenſive. The principal [illegible]
employed by nature for this end is what [illegible]
crates calls concoction. By this he [illegible]
the bringing the morbific matter lodged in the
humours to ſuch a ſtate, [illegible] fitted for
expulſion by whatever means [illegible]
moſt proper. When matters [illegible]
this paſs, whatever is [illegible] im-
mediately empties [illegible]
phyſicians the way by which [illegible]
is to be accompliſhed. [illegible]
either by bleeding [illegible]
cuations, tumours [illegible]
ſpots, &c. But [illegible]
as the effects of a [illegible]
conſiderable quantity; ſmall [illegible]
ing ſufficient to make a criſis. On [illegible]
ſmall diſcharges are a ſign that Nature is de-
preſſed by the load of humours, and that ſhe lets
them go through weakneſs and continual irrita-
tion. What comes forth in this manner is crude,
becauſe the diſtemper is yet too ſtrong; and
while matters remain in this ſtate, nothing but a
bad or *imperfect criſis* is to be expected. This
ſhows that the diſtemper triumphs, or at leaſt
is equal in ſtrength to nature, which prognoſti-
cates death, or a prolongation of the diſeaſe. In
this laſt caſe, however, Nature often has an op-

portunity

[illegible]rtunity of attempting a new crisis more happy than the former, after having made fresh efforts to advance the concoction of the humours.—It must here be observed, however, that according to Hippocrates, concoction cannot be made but in a certain time, as every fruit has a limited time to ripen, for he compares the humours which [illegible] to fruits come to maturity.

Critical days.

Hippocrates [illegible] remarked the *critical* [illegible] the cases in which fevers were [illegible] to have a crisis were the third, [illegible] eleventh, fourteenth, seven-[illegible]. If this happened kindly [illegible] the patients, he remarked, [illegible] they sunk under their [illegible]

His accuracy in prognostics.

[illegible] contributed to procure [illegible] paid to Hippocrates, is [illegible] the most minute cir-cumstances of [illegible] and his exactness in nicely delineating every thing that happened before, and every [illegible] that appeared at the same time with them, [illegible] likewise what appeared to give ease, and what to increase the malady: which is what we may call *writing the history of a disease.* Thus he not only distinguished one disease from another by the signs which properly belonged to each; but by comparing the same sort of distemper which happened to several persons, and the accidents which usually appeared before and

 after,

after, he could often foretel a disease before it came, and afterwards give a right judgment of the event of it. By this way of *prognosticating*, he came to be exceedingly admired: and this he carried to such a height, that it may justly be said to be his master-piece; and Celsus, who lived long after him, remarks, that succeeding physicians, though they found out several new things relating to the management of diseases, yet were obliged to the writings of Hippocrates for all that they knew of signs.

From this account of Hippocrates, it will appear, that he was not near so much taken up with reasoning on the phenomena of diseases, as with reporting them. He was content to observe these phenomena accurately, to distinguish diseases by them, and judged of the event by comparing them exactly together. For his skill in prognostics he was indeed very remarkable, as we have already mentioned, insomuch that he and his pupils were looked upon by the vulgar as prophets. What adds very much to his reputation is, that he lived in an age when physic was altogether buried in superstition, and yet he did not suffer himself to be carried away by it; on the contrary, on many occasions, he expresses his abhorrence of it.

Having thus seen in what Hippocrates makes the difference between health and sickness to consist, and likewise the most remarkable signs from

from whence he drew his prognostics, we must now consider the means he prescribed for the preservation of health, and the cure of diseases. One of his principal maxims was this, That, to preserve health, we ought not to overcharge ourselves with too much eating, nor neglect the use of exercise and labour. In the next place, That we ought by no means to accustom ourselves to too nice and exact a method of living; because those who have once begun to act by this rule, if they vary in the least from it, find themselves very ill; which does not happen to those who take a little more liberty, and live somewhat more irregularly. Notwithstanding this, he does not neglect to inquire diligently into what those who were in health used for food in his time. Here we cannot help taking notice of the prodigious disparity between the delicacy of the people in our days and in those of Hippocrates: for he takes great pains to tell the difference between the flesh of a dog, a fox, a horse, and an ass; which he would not have done if at that time they had not been used for victuals, at least by the common people. Besides these, however, Hippocrates speaks of all other kinds of provision that are now in use; for example, salads, milk, whey, cheese, flesh as well of birds as of four-footed beasts, fresh and salt fish, eggs, all kinds of pulse, and the different kinds of grain we feed on, as well as the

His maxims for the preservation of health.

Diet

different sorts of bread that are made of it. He also speaks very often of a sort of liquid food, or broth, made of barley-meal, or some other grain, which they steeped for some time, and then boiled in water. With regard to drink, he takes a great deal of pains to distinguish the good waters from the bad. The best, in his opinion, ought to be clear, light, without smell or taste, and taken out of the fountains that turn towards the east. The salt-waters, those that he calls hard, and those that rise out of fenny ground, are the worst of all; he condemns also those that come from melted snow. But though Hippocrates makes all those distinctions, he advises those who are in health to drink of the first water that comes in their way. He advises to mix wine with an equal quantity of water: and this (he says) is the just proportion; by using which the wine will expel what is hurtful to the body, and the water will serve to temper the acrimony of the humours.

"For those that are in health, and likewise for such as are sick, Hipporrates advises exercise. The books, however, which treat on this subject, some conjecture to have been written by Herodicus, who first introduced gymnastic exercise into medicine. The advice given, consists mostly in directions for the times in which we ought to walk, and the condition we ought to be in before it; when we ought to walk slowly, and

when to run, &c.; and all this with respect to different ages and temperaments, and with design to bring the body down, or dissipate the humours. Wrestling, although a violent exercise, is numbered with the rest. In the same place also mention is made of a play of the hands and fingers, which was thought good for health, and called *chironomie*; and of another diversion which was performed round a sort of ball hung up, which they called *corycus*, and which they struck forward with both their hands.

With regard to those things which ought to be separated from, or retained in the human body, Hippocrates observes, that people ought to take great care not to load themselves with too much food too long retained; and besides the exercise above mentioned, which carries off one part of them, and which he prescribed chiefly on this account, he advises people to excite and rouse up nature when she flagged, and did not endeavour to expel the other, or take care of the impediments by which she was resisted. For this reason he prescribed meats proper for loosening the belly; and when these were not sufficient, he directed aperient medicines.

In his writings are likewise to be found several remarks concerning good and bad air; and he makes it appear that the good or bad disposition of this element does not depend solely on the dif-

ference

ference of the climate, but on the situation of every place in particular.

Passions. He speaks also of the good and bad effects of the passions, and recommends moderation in regard to them.

Practice of Hippocrates. From what we have already related concerning the opinions of Hippocrates, it may naturally be concluded, that for the most part he would be contented with observing what the strength of Nature is able to accomplish without being assisted by the physician. That this was really the case, may be easily perceived from a perusal of his book entitled, "Of epidemical distempers;" which is, as it were, a journal of the practice of Hippocrates; for there we find him often doing nothing more than describing the symptoms of a distemper, and informing us what has happened to the patient day after day, even to his death or recovery, without speaking a word of any kind of remedy. Sometimes, however, he did indeed make use of remedies; but these were exceedingly simple and few, in comparison of what have been given by succeeding practitioners. These remedies we shall presently consider, after we have given an abridgment of the principal maxims upon which his practice is founded.

His maxims for the cure of diseases. Hippocrates asserted in the first place, That contraries, or opposites, are the remedies of each other; and this maxim he explains by an apho-

rism; in which he says, that evacuations cure those distempers which come from repletion, and repletion those that are caused by evacuation. So heat is destroyed by cold, and cold by heat, &c. In the second place, he asserted, that physic is an addition to what is wanting, and a subtraction or retrenchment of what is superfluous, an axiom which is explained by this, viz. that there are some juices or humours, which in particular cases ought to be evacuated, or driven out of the body, or dried up; and some others which ought to be restored to the body, or caused to be produced there again. As to the method to be taken for this addition or retrenchment, he gives this general caution, That you ought to be careful how you fill up, or evacuate all at once, or too quickly, or too much; and that it is equally dangerous to heat or cool again on a sudden; every thing that runs to an excess, says he, being an enemy to Nature. In the fourth place, Hippocrates allowed that we ought sometimes to dilate, and sometimes to lock up: to dilate, or open the passages by which the humours are voided naturally, when they are not sufficiently opened, or when they are closed; and, on the contrary, to lock up or straiten the passages that are relaxed, when the juices that pass there ought not to pass, or when they pass in too great quantity. Hippocrates gives also the following instruction, That when we do any thing according

ing to reafon, though the fuccefs be not anfwerable, we ought not too eafily, or too haftily, to alter our manner of acting, as long as the reafons for it feem good. But as this maxim might fometimes prove deceitful, he gives the following as a corrector to it: We ought (fays he) to mind with a great deal of attention what gives eafe, and what creates pain; what is eafily fupported, and what cannot be endured. We ought not to do any thing rafhly; but ought often to paufe, or wait, without doing any thing: by this way, if you do the patient *no good*, you will at leaft do him *no hurt*.

Thefe are the principal and moft general maxims of the practice of Hippocrates, and which proceed upon the fuppofition laid down at the beginning, viz. "*that Nature cures difeafes.*" We next proceed to confider particularly the remedies employed by him, which will ferve to give us a further infight concerning his practice.

His maxims refpecting diet in difeafe.

Diet was the firft, the principal, and often the only remedy made ufe of by this great phyfician to anfwer the greateft part of the intentions above mentioned: by means of it he oppofed ftrength to difeafe, and fupported Nature to overcome the malady. The dietetic part of medicine was fo much the invention of Hippocrates himfelf, that he fays exprefsly, the ancients had wrote almoft nothing concerning the diet of the fick, having omitted

omitted this point, though it was one of the most essential parts of the art.

The diet prescribed by Hippocrates for patients labouring under acute distempers, differed from that which he ordered for those afflicted with chronic ones. In the former, which require a more particular exactness in relation to diet, he preferred liquid food to that which was solid. For these he used a sort of broth made of cleansed barley; and to this he gave the name of *Ptisan* *. He preferred the ptisan to all other food in fevers, because it softened and moistened much, and was besides of easy digestion. If he was concerned in a continual fever, he would

* The manner in which the ancients prepared their ptisan was as follows. They first steeped the barley in water till it was plumped up, and afterwards they dried it in the sun, and beat it to take off the husk. They next ground it; and having let the flour boil a long time in the water, they put it out into the sun, and when it was dry they pressed it close. It is properly this flour so prepared that is called *ptisan* They did almost the same thing with wheat, rice, lentils, and other grain: and they gave these ptisans the name of the grain from whence they were extracted, as *ptisan of lentils, rice*, &c. but the ptisan of barley was called simply *ptisan*, on account of the excellency of it. When they wanted to use it, they boiled one part of it in ten or fifteen of water; and when it began to grow plump in boiling, they added a little vinegar, and a very small quantity of anise or leek, to keep it, as they thought, from clogging or filling the stomach with wind.

have

have the patient begin with a ptisan of a pretty thick consistence, and go on by little and little, lessening the quantity of barley-flour as the height of the distemper approached; so that he did not feed the patient but with what he called the *juice of the ptisan*, that is, the ptisan strained, where there was but very little of the flour remaining, in order that Nature being discharged in part from the care of digesting the aliments, she might the more easily hold out to the end, and overcome the distemper or the cause of it. In the paroxysm of a fever he gave nothing at all, and in all distempers where there are exacerbations, he forbids nourishment while the exacerbations continue. He let children eat more, but those who were grown up to man's estate, or were of an advanced age, less, making allowance, however, for the custom of each particular person, or for that of the country.

But though he was of opinion that too much food ought not to be allowed to the sick, he was not of the mind of some physicians who prescribed long abstinence, especially in the beginning of fevers. The reason he gave of this was, that the contrary practice weakened the patients too much during the first days of the distemper, by which means their physicians were obliged to allow them too much food when the illness was at its height, which in his opinion was improper. Besides, in acute distempers, and particularly in fevers,

fevers, Hippocrates made choice of refreshing nourishment; and amongst other things prescribed orange, melon, spinach, gourd, and dock.

The drink he commonly gave to his patients was made of eight parts of water and one of honey. In some distempers they added a little vinegar.

Drinks.

These are the most remarkable particulars concerning the diet prescribed by Hippocrates in acute distempers; in chronical ones he made use very much of milk and whey; though we are not certain whether this was done on account of the nourishment expected from them, or that he accounted them as medicines.

Diet in chronic diseases.

There are many diseases for which he judged the bath was a proper remedy; and he takes notice of all the circumstances that are necessary in order to cause the patient to receive benefit from it, among which the following are the principal. The patient that bathes himself must remain still and quiet in his place without speaking while the assistants are wiping him dry. He must not bathe immediately after eating and drinking, nor eat or drink immediately after coming out of the bath. Regard must also be had whether the patient had been accustomed to bathe while in health, and whether he has been benefited or hurt by it. Lastly, he must abstain from the bath when the body is too open, or too costive,

His maxim respecting bathing.

or when he is too weak; or if he has an inclination to vomit, a great loss of appetite, or bleeds at the nose.

His maxims respecting exercise.

In chronical distempers Hippocrates approved very much of exercise, though he did not allow of it in acute ones: but even in these he did not think that a patient ought always to lie a-bed; but tells us, that "we must sometimes order the timorous out of bed, and rouse up the lazy."

His maxims respecting purgatives.

When he found that diet and exercise were not sufficient to ease nature of a burden of corrupted humours, he was obliged to make use of other means, of which purgation was one. By this word he understood all the contrivances that are made use of to discharge the stomach and bowels; though it commonly signifies only the evacuation of the body. Most of the purgatives used in his time were emetics also, or at least were very violent in their operation downwards. These were the white and black hellebore; the first of which is now reckoned among the poisons. He used also the Cnidian berries, which are nothing else but the seeds of thymelea or chamœlea; cneorum peplium, which is a sort of milk-thistle; thapsia; the juice of hippophaë, a sort of rhamnus; elaterium, or juice of the wild cucumber; flowers of brass, coloquintida, scammony, the magnesian stone, &c.

As these purgatives were all very strong, Hippocrates

pocrates was extremely cautious in their exhibition. He did not prescribe them in the dog-days; nor did he ever purge women with child, and very seldom children or old people. He principally used purgatives in chronical distempers; but was much more wary in acute ones. In his books intitled "Of Epidemical Distempers," there are very few patients mentioned to whom he gave purgative medicines. He also takes notice expressly, that these medicines having been given in cases of the distempers of which he was treating, had produced very bad effects. We are not, however, from this to conclude, that Hippocrates absolutely condemned purging in acute distempers; for in some places he expressly mentions his having given them with success. He was of opinion, for instance, that purging was good in a pleurisy; and in this case he gave black hellebore, or some peplium mixed with the juice of *laserpitium*.

Hippocrates imagined that each purgative medicine was adapted to the carrying off some particular humour; and hence the distinction of purgatives into *hydragogue*, *cholagogue*, &c. which is now justly exploded. In consequence of this notion, which prevailed long after his time, he pretended that we knew if a purgative had drawn from the body what was fit to be evacuated according as we found ourselves well or ill upon it. If we found ourselves well, it was a sign

 tha

that the medicine had effectually expelled the offending humour. On the contrary, if we were ill, he imagined, whatever quantity of humour came away, that the humour which caused the illness still remained; not judging of the goodness or badness of a purge by the quantity of matters that were voided by it, but by their quality and the effect that followed after it *.

Vomits were also pretty much used as medicines by Hippocrates. He seldom, as we before observed, used them with a single intent: for when he had a mind to recal the humours, as he termed it, from the inmost recesses of the body, he made use of brisker remedies. Among these was white hellebore, and this indeed he most frequently used to excite vomiting. He gave this root particularly to melancholy and mad people; and from the great use made of it in these cases by Hippocrates and other ancient physicians, the phrase *to have need of hellebore*, became a proverbial expression for being out of one's senses. He gave it also in defluxions, which come, according to him, from the brain, and throw themselves on the nostrils or ears, or fill the mouth with saliva, or that cause stubborn pains in the head, and a weariness or an extraordinary heaviness, or a weak-

* Even Hippocrates, we find, had some kind of theory, which in some measure guided his practice; although he is generally reputed to be the father of the empiric sect.

ness

neſs of the knees, or a ſwelling all over the body. He gave it to conſumptive perſons in broth of lentils, to ſuch as were afflicted with the dropſy called *leucophlegmatia*, and in other chronical diſorders. But we do not find that he made uſe of it in acute diſtempers, except in the cholera morbus, where he ſays he preſcribed it with benefit. Some took this medicine faſting; but moſt took it after ſupper, as was commonly practiſed with regard to vomits taken by way of prevention. The reaſon why he gave this medicine moſt commonly after eating was, that by mixing with the aliments, its acrimony might be ſomewhat abated, and it might operate with leſs violence on the membranes of the ſtomach. With the ſame intention alſo he ſometimes gave a plant called *ſeſamoides*, and ſometimes mixed it with hellebore. Laſtly, in certain caſes he gave what he called *ſoft* or *ſweet* hellebore. This term had ſome relation to the quality of the hellebore, or perhaps to the quantity he gave of it.

When Hippocrates intended only to keep the body open, or evacuate the contents of the inteſtines, he made uſe of ſimples; as for example the herb mercury, or cabbage; the juice or decoction of which he ordered to be drank. For the ſame purpoſe he uſed whey, alſo cows and aſſes milk; adding a little ſalt to it, and ſometimes letting it boil a little. If he gave

asses milk alone, he caused a great quantity of it to be taken, so that it must of necessity loosen the body. In one place he prescribes no less than *nine pounds* of it to be taken as a laxative, but does not specify the time in which it was to be taken. With the same intention he made use of suppositories and clysters. The former were compounded of honey, the juice of the herb mercury, of nitre, powder of colocynth, and other sharp ingredients, to irritate the rectum. These they formed into a ball, or into a long cylindrical mass. The clysters he made use of for sick people were sometimes the same with those just mentioned as preventives for people in health. At other times he mixed the decoction of herbs with nitre, honey, and oil, or other ingredients, according as he imagined he could by that means attract, wash, irritate, or soften. The quantity of liquor he ordered was about 36 ounces; from which it is probable he did not intend that it should all be used at one time.

On some occasions Hippocrates proposed to purge the head alone. This practice he employed, after purging the rest of the body, in an apoplexy, inveterate pains of the head, a certain sort of jaundice, a consumption, and the greatest part of chronical distempers. For that purpose he made use of the juices of several plants, as celery; to which he sometimes added aromatic drugs, making the patients snuff up this mixture

into their noftrils. He ufed alfo powders compounded of myrrh, the flowers of brafs, and white hellebore, which he caufed them to put up into the nofe, to make them fneeze, and to draw the phlegm from the brain. For the fame purpofe alfo he ufed what he calls *tetragonon*, that is, "fomething having four angles;" but what this was, is now altogether unknown, and was fo even in the days of Galen. The latter phyfician, however, conjectures it to be antimony, or certain flakes found in it.

In the diftemper called *empyema* (or a collection of matter in the breaft), he made ufe of a very rough medicine. He commanded the patient to draw in his tongue as much as he was able; and when that was done, he endeavoured to force into the ftomach a medicine that would irritate the part, which, raifing a violent cough, obliges the lungs to difcharge the purulent matter contained in them. The materials that he ufed for this purpofe were of different forts; fometimes he took the root of arum, which he ordered to be boiled with a little falt, in a fufficient quantity of water and oil; diffolving a little honey in it. At other times, when he intended to affect more ftrongly, he took the flowers of copper and hellebore; after that he fhook the patient violently by the fhoulders, the better to loofen the pus. This remedy, according to Galen, he received from the Cnidian phy-

ficians; and it has never been used by the succeeding ones, probably because the patients could not allow of it; a sea voyage answering the purpose better.

Blood-letting was another method of evacuation pretty much used by Hippocrates. Another aim he had in this, besides the mere evacuation, was to divert or recall the course of the blood when he imagined it was going where it ought not. With regard to this evacuation, his conduct was much the same as to purging, in respect of time and persons. We ought, says he, to let blood in acute diseases, when they are violent, if the party be lusty and in the flower of his age. We ought also to have regard to the time, both in respect to the disease and to the season in which we let blood. He also informs us, that blood ought to be let in great pains, and particularly in inflammations. Among these he reckons such as fall upon the principal viscera, as the liver, lungs, and spleen, as also the quinsy and pleurisy, if the pain of the latter be above the diaphragm. In a quinsy he blooded in both arms at once. Difficulty of breathing he also reckons among the distempers that require bleeding; and he mentions another sort of inflammation of the lungs, which is accompanied with great heat in that part, in which case he advises to bleed in all parts of the body; and directs particularly to the arms, tongue, and nostrils.

noſtrils. To make bleeding the more uſeful in all pains, he directed to open the vein neareſt the part affected; in a pleuriſy he directs to take blood from the arm of the ſide affected; and for the ſame reaſon, in pains of the head, he directs the veins of the noſe and forehead to be opened. When the pain was not urgent, and bleeding was adviſed by way of prevention, he directed the blood to be taken from the parts fartheſt off, with a deſign to divert the blood inſenſibly from the ſeat of pain. The higheſt burning fevers, which ſhow neither ſigns of inflammation nor pain, he does not rank among thoſe diſtempers that require bleeding. On the contrary, he maintains that a fever itſelf is in ſome caſes a reaſon againſt bleeding. If any one, ſays he, has an ulcer in the head, he muſt bleed, *unleſs he has a fever*. He ſays further, thoſe that loſe their ſpeech of a ſudden, muſt be blooded, unleſs they have a fever. Perhaps he was afraid of bleeding in fevers, becauſe he ſuppoſed that they were produced by the bile and pituita, which heated the whole body, which is, ſays he, what we call *fever*, and which in his opinion cannot well be evacuated by bleeding. In other places alſo he looks upon the preſence or abundance of bile to be an objection to bleeding; and he orders to forbear veneſection even in a pleuriſy, if there be much bile. To this we muſt add, that Hippocrates diſtinguiſhed very particularly between

tween a fever which followed no other diſtemper, but was itſelf the original malady, and a fever which came upon inflammation. In the early ages of phyſic, the firſt were only properly called *fevers*: the others took their names from the parts affected; as pleuriſy, peripneumony, hepatitis, nephritis, &c. which names ſignify that the pleura, the lungs, the liver, or the kidneys, are diſeaſed, but do not intimate the fever which accompanies the diſeaſe. In this latter ſort of fever Hippocrates conſtantly ordered bleeding, but not in the former. Hence in his books of Epidemic Diſtempers, we find but few directions for bleeding in the great number of continual and burning fevers there treated of. In the firſt and third book we find but one ſingle inſtance of bleeding, and that in a pleuriſy; in which, too, he ſtaid till the eighth day of the diſtemper.

With regard to the rules laid down by Hippocrates for bleeding, we muſt further take notice, that in all diſeaſes which had their ſeat above the liver, he blooded in the arm, or in ſome of the upper parts of the body; but for thoſe that were ſituated below it he opened the veins of the foot, or ancle. If the belly was too laxative, and bleeding was at the ſame time thought neceſſary, he ordered the looſeneſs to be ſtopped before bleeding.

Hippocrates let blood alſo in a dropſy, even in a tympany; and in both caſes he preſcribes

bleeding

bleeding in the arm. In a disease occasioned by an overgrown spleen, he proposes bleeding several times repeated at a vein of the arm which he calls the *splenetic*. On some occasions he took away great quantities of blood, as appears from what we have already observed. Sometimes he continued the blooding till the patient fainted: at other times he would let blood in both arms at once; at others, he did it in several places of the body, and at several times. The veins he opened were those of the arm, the hands, the ancles on both sides, the hams, the forehead, behind the head, the tongue, the nose, behind the ears, under the breasts, and those of the arms; besides which, he burnt others, and opened several arteries. He likewise used cupping-vessels, with intent to recal or withdraw the humours which fell upon any part. Sometimes he contented himself with the bare attraction made by the cupping-vessels, but sometimes he also made scarifications.

When bleeding and purging, which were the principal and most general means used by Hippocrates, proved insufficient, he had recourse to diuretics and sudorifics. The former were of different sorts, according to the constitution of the persons: sometimes baths, and sometimes sweet wine, were employed to provoke urine; sometimes the nourishment which we take contributes to it: and amongst those herbs which *His maxims respecting diuretics and sudorifics.*

are

are commonly eaten, Hippocrates recommends garlic, leeks, onions, cucumbers, melons, gourds fennel, and all other things which have a [illegible] taste and a strong smell. With these he [illegible] honey, mixed with water or wine [illegible] meats. But, on some occasions, [illegible] cantharides, and, pulling off their [illegible] gave them in wine and [illegible] The [illegible] were given in a great number of [illegible] tempers after purging, in [illegible] or when it was made in less quan[illegible] ought. There were also [illegible] cases in which [illegible] would force sweat as well as urine; [illegible] ther mentions the diseases in which [illegible] proper, nor lets us know what [illegible] be used for this purpose [illegible] passage, where he ment[illegible] upon the head a great [illegible] feet sweat; that is, till [illegible] over the whole body, [illegible] After this he would have [illegible] at [illegible] meat, and drink pure wine, and [illegible] covered with clothes, lay themselves down to rest. The disease for which he proposes the above mentioned remedy is a fever; which is not, according to him, produced by bile or pituita, probably he meant rheumatism; from whence we may conclude that he did not approve of sweating in any other kind of fever.

Lastly,

Lastly, besides the medicines already mentioned, which acted in a sensible manner, Hippocrates made use of others called specifics; whose operation he did not see, and for the use of which he could give no reason besides his own experience, or that of other physicians. These he had learned from his predecessors the descendants of Æsculapius, who, being *empirics*, did not trouble themselves about inquiring into the operation of their remedies, provided their patients were cured. To these he joined *anodynes*, or such things as procure sleep; but these last were used but seldom; and, it is most probable, were only preparations of poppies.

The use he made of specifics and opium.

The compound medicines given inwardly by Hippocrates were either *liquid*, *solid*, or *lambative*. The liquid ones were prepared either by decoction or infusion in a proper liquor, which, when strained, was taken for use; or by macerating certain powders in such liquors, and so taking them together, or by mixing different kinds of liquors together. The solid medicines consisted of juices inspissated, or of gums, resins, or powders, made up with them or with honey, or something proper to give the necessary consistence to the medicine. These were made up in a form and quantity fit to be swallowed with ease. The lambative was of a consistence between solid and fluid; and the patients were obliged to keep it for some time to dissolve in the mouth, that

Of compound medicines.

they

they might ſwallow it leiſurely. This remedy was uſed to take off the acrimony of thoſe humours which ſometimes fall upon this part, and provoke coughing and other inconveniences. The baſis of this laſt compoſition was honey. It is worth our obſervation, that the compound medicines of Hippocrates were but very few, and compoſed only of four or five ingredients at moſt; and that he not only underſtood pharmacy, or the art of compounding medicines, but prepared ſuch as he uſed himſelf, or cauſed his ſervants to prepare them in his houſe by his directions.

We have thus given ſome account of the ſtate of medicine as practiſed and taught by Hippocrates, who, as we have already obſerved, has for many ages been juſtly conſidered as the father of phyſic. For when we attend to the ſtate in which he found medicine, and the condition in which he left it, we can hardly beſtow ſufficient admiration on the judgment and accuracy of his obſervations.

Character of Hippocrates.

The divine Hippocrates is always ſure to repreſent things as they are in their own natures. He has no intereſted views to ſerve, no particular bias to draw him aſide from truth. He is always clear, always conciſe, and intelligible. He no-where obſcures his meaning, throws a cloud over the nature of diſorders, or miſrepreſents their ſymptoms and terminations, by the unintelligible jargon of the four elements, or the ſtill

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more abſurd and ridiculous whim of the four primary qualities reſulting from them. Vain and idle controverſies concerning the firſt temperament of the ſimple ſtamina of life never hinder him from penetrating into the true events of things. The purity and glory of his compoſitions are not ſtained and ſullied with the uſeleſs notions of the *calidum innatum*, and the *humidum radicale*. Subtile and uninſtructive diſtinctions of diſeaſes, and their ſeveral cauſes, are not to be met with in the works of this venerable parent of the healing art. Theſe were nice diſtinctions which his exalted genius, and well-formed taſte, deſpiſed. He was no leſs conſpicuous for the impartiality of his repreſentations, than the force and ſtrength of his genius, for he no-where aſſerts things which he had not ſeen, nor does he ever neglect to give a faithful account of real circumſtances. He repreſents, but does not diſguiſe or change, the operations of nature, in order to procure honour or ſtability to any particular hypotheſis. We ought carefully to peruſe the plain, the ſimple writings of Hippocrates, in which the ſacred oracles of nature herſelf are delivered pure and uncontaminated; where nothing is darkened by an obſcurity of words; where every line is richly pregnant with thought and ſenſe; and where the moſt important truths are told at once with Laconic brevity, and Attic perſpicuity. But there are ſtill other circumſtances

of

of greater moment, which render the divine Hippocrates juſtly preferable to all others: witneſs his unwearied and indefatigable attention of mind, which enabled him to view every circumſtance in the moſt proper light; witneſs his unwearied and incomparable diligence, by which he inveſtigated and diſcovered every thing which had the leaſt tendency to clear his ſubject; witneſs the noble and generous freedom with which he conveyed his uſeful labours to the world. Whichever of theſe the impartial mind conſiders, the divine Hippocrates will be found great beyond the poſſibility of a rival. Among the numberleſs inſtances in which he improved both that knowledge he had received from his anceſtors, and that which he had learned in foreign nations, there is one of a ſingular nature, and entirely peculiar to himſelf, which deſerves to be recorded; he ſent his elder ſon Theſſalus into Theſſaly, Draco his younger ſon to the Helleſpont, Polybus his ſon-in-law to another quarter of Greece, and a large number of his ſcholars all over the country, after having duly inſtructed them in the principles of their art, and furniſhed them with every thing neceſſary for practice. Theſe were ordered to cure the ſick expoſed on the highways, to obſerve the terminations of diſeaſes, to attend carefully to the operations and effects of medicines, and to give a faithful and impartial account of all to their great and worthy countryman Hippocrates. Theſe, to be

be ſure, were a ſet of the moſt fortunate circumſtances that ever yet concurred to the formation of any one phyſician; and Hippocrates well knew how to make the beſt advantage of them, for from the labours and obſervations of this large number of phyſicians, formed upon his own model, judging, as it were, with his own eyes, and practiſing upon his own principles, he formed, conſidering the times, the moſt perfect, the moſt extenſive, and the moſt judicious body of phyſic. Other phyſicians ſee only with their own eyes, but Hippocrates ſaw alſo with thoſe of others. Moſt practitioners draw their knowledge from a ſcanty number of patients, but Hippocrates was ſupplied from every part of Greece. Few practical authors have deſcribed the diſeaſes which rage in a ſingle town, but Hippocrates has judiciouſly animadverted on all the diſorders that occurred through all the towns, villages, and provinces of Greece. This is, no doubt, a ſufficient reaſon why Hippocrates ſhould appear ſo much ſuperior to others, who were deſtitute of the like opportunities, and placed in leſs favourable circumſtances: hence it happens, that his labours have ſtood the ſhocks of envy, the aſſaults of oppoſers, and the malice of critics, for ſo many centuries, and, like burniſhed ſteel, become the more bright and reſplendent by attrition. When peruſed with the niceſt judgment and the ſtricteſt care, the ſmalleſt inconſiſtency cannot be found,

and truth and nature every where appear in their most awful and commanding shapes. Upon the whole, so accurate and extensive was the skill of Hippocrates, that the learned Greeks, the polite Romans, and the industrious Arabians, have done nothing but repeat and confirm his doctrines. The Illyrians and Peonians adored him as something more than human, and Barbarian kings publicly implored him as their tutelar genius; powerful and opulent nations rewarded his merit by munificent presents; and histories inform us, that physicians have, in all ages, been recommended to potentates, and loaded with glory, honour, and riches, by treading in the steps of Hippocrates.

Galen, who flourished five hundred years after Hippocrates, although a great admirer of him, differed essentially from this great father of physic. Hippocrates was conducted chiefly by experience, and his works are a collection or record of *facts*, whereas Galen indulged in the most extravagant *theories* and idle disputations; and, as it is easy to be wrong in ratiocination, whereas experience, on the contrary, must be admitted by all parties, the works of Hippocrates have afforded very little matter of exception to the physicians who came after him, whereas the doctrines of Galen divided the faculty into two sectaries.

Galen for the most part followed the plan of Hippocrates, in the treatment of diseases. But a

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the *materia medica* in the course of five hundred years had been much augmented, the prescriptions of Galen were devoid of the Hippocratic simplicity. And it is more than probable that his false and ridiculous theory, concerning the primary qualities of hot and cold, dry and moist, led him into dangerous errors in the composition of medicines.

Two great sects were in consequence established: those who followed Hippocrates were styled empyrics, from the Greek word εμπειρια, experience (a word shamefully abused); and the other physicians, in the general acceptation of the word.

After the downfal of the Roman empire, and when the inundation of Goths and Vandals had almost completely exterminated literature of every kind in Europe, medicine, though a practical art, shared the same fate with more abstract sciences. Learning in general, banished from the seat of arms, took refuge among the eastern nations, where the arts of peace still continued to be cultivated. To the Arabian physicians, as they have been called, we are indebted both for the preservation of medical science, as it subsisted among the Greeks and Romans, and likewise for the description of some new diseases, particularly the small-pox. Among the most eminent of the Arabians, we may mention Rhases, Avicenna, Albucasis, and Avenzoar. But of their writings it

would be tedious, and is unnecessary to give any particular account.—They were for the most part, indeed, only copiers of the Greeks; we are, however, indebted to them for some improvements. They were the first who introduced chemical remedies, though of these they used but few, nor did they make any considerable progress in the chemical art. Anatomy was not in the least improved by them, nor did surgery receive any advancement till the time of Albucasis, who lived probably in the 12th century. They added a great deal to botany and the materia medica, by the introduction of new drugs, of the aromatic kind especially, from the east, many of which are of considerable use. They also found out the way of making sugar; and by help of that, syrups; which two new materials are of great use in mixing up compound medicines.

With regard to their practice, in some few particulars they deviated from the Greeks. Their purging medicines were much milder than those formerly in use; and even when they did prescribe the old ones, they gave them in a much less dose than formerly. The same reflection may be made concerning their manner of bleeding, which was never to that excessive degree practised by the Greeks. They deviated from Hippocrates, however, in one very trivial circumstance, which produced a violent controversy. The question was, Whether blood in a pleurisy ought

ought to be drawn from the arm of the affected side or the opposite? Hippocrates had directed it to be drawn from the arm of the affected side; but the Arabians, following some other ancient physicians, ordered it to be drawn from the opposite one. Such was the ignorance of those ages, that the university of Salamanca in Spain made a decree, that no one should dare to let blood but in the contrary arm; and endeavoured to procure an edict from the emperor Charles V. to second it; alleging that the other method was of no less pernicious consequence to medicine, than Luther's heresy had been to religion.

In consequence of the general decay of learning in the western parts of the world, the Greek writers became totally forgot, because nobody could read the language; and the Arabians, though mostly copiers from them, enjoyed all the reputation that was due to the others. The Arabian physic was introduced into Europe very early, with the most extravagant applause: and not only this, but other branches of their learning, came into repute in the west; insomuch that in the 11th century, the studies of natural philosophy and the liberal arts were called *the studies of the Saracens.* This was owing partly to the crusades undertaken against them by the European princes; and partly to the settlement of the Moors in Spain, and the intercourse they and other Arabians had with the Italians. But, long

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before the time of the crusades, probably in the middle of the 7th century, there were Hebrew, Arabic, and Latin professors of physic settled at Salernum: which place soon grew into such credit, that Charles the Great thought proper to found a college there in the year 802; the only one at that time in Europe. Constantine, the African, flourished here towards the latter end of the 11th century. He was a native of Carthage; but travelled into the east, and spent 30 years in Babylon and Bagdad, by which means he became master of the oriental languages and learning. He returned to Carthage; but being informed of an attempt against his life, made his escape into Apulia, where he was recommended to Robert Guiscard, created in 1060 duke of that country, who made him his secretary. He was reputed to be very well versed in the Greek, as well as the eastern tongues; and seems to have been the first who introduced either the Greek or Arabian physic into Italy. His works, however, contain nothing that is new, or material; though he was then counted a very learned man, and for that age no doubt was so.

The Arabian physicians, instead of pursuing the road which would finally conduct to a true knowledge of medicine, which is properly defined to be "the healing art," only added to the subtleties of Galen, and composed books as commentaries on him full of the most empty and

unmeaning

unmeaning ideas. This suited, however, the age, for people of those days were so delighted with the extraordinary and marvellous, that they were not satisfied with what was level to their comprehensions; but required something sublime and unintelligible, which might exercise their imaginations, although it confounded their ideas; so true is the expression of Tacitus, Quidquid ignotum vulgo pro magnifico semper habebatur; or, as Lucretius observes,

Omnia enim stolidi magis admirantur, amantque
Inversis quæ sub verbis latitantia cernunt.

It is certain that the method of Hippocrates was preferable for the advancement of the science of medicine to that of Galen. Nevertheless, on the other hand, as all things depend upon some certain cause, it would be of infinite service to medicine, if these could be demonstrated and made plain beyond all possibility of contradiction: for this would give the most certain deduction for cure; but wherever theory is doubtful it cannot be trusted to in practice, and may lead into the most dangerous errors. The abuse therefore, and not the use of ratiocination, is to be condemned. Hypothesis cannot mislead men of judgment, who can distinguish it from demonstration, but theory, in the hands of men of wild imagination and weak judgment, is certainly too capable of producing much mischief.

Erasistratus. Erasistratus reasoning on false and precarious principles, and neglecting experience, the sole test of utility, proscribes the use of venæsection and purgatives, and condemns them as remedies equally infamous and dangerous.

Asclepiades. Asclepiades, from whom the modern sect of mechanics have borrowed many of their doctrines, supposing that health depends on the just proportion between the pores of the body and certain corpuscles, which they are destined to receive and transmit, and that it is impaired whenever these corpuscles are obstructed in their passage, orders exercise on horseback in the most ardent fevers. He advances it as a maxim, that one fever is to be cured by raising another; and that the strength of the patient is to be exhausted by watching, and the endurance of thirst. And his practice was strictly and severely conformable to his principles; for he would not allow the sick to cool their mouths with a drop of water, during the two first days of the disorder. But he indulged his phrenitic patients in the use of wine, even to intoxication.

Themison. Themison, the disciple of Asclepiades, rejected some of the opinions of his master, and founded a new sect, called the Methodists. But his practice did not materially differ from that of Asclepiades.

Oribasius, Ætius, Alexander, Trallianus, Paulus Ægineta, and their successors the Arabian physicians, attempted no material innovations, but humbly

humbly trod in the footsteps of Galen. The Arabians indeed introduced several new and valuable medicines into practice, such as manna, senna, tamarinds, cassia, and rhubarb. And by the cultivation of chemistry, they laid a foundation for the greatest and most important revolutions in the art of medicine. I omit the mention of Albertus Magnus, Arnoldus de Villa Nova, Ramund Lully, Johannes de Rupescissa, Isaac and John Hollandus, and Basil Valentine, who were all chemists, many of them inventors of *panaceas*, and the authors of much mischief.

When, after many ages of darkness, which had destroyed almost the whole of ancient literature, learning was again restored in the fifteenth century; it was the system of Galen alone that the physicians of those days became acquainted with; and during the course of the sixteenth century, the study of physicians was almost solely employed in explaining and confirming that system. At this period the medical knowledge of Europe was chiefly, and, indeed, solely, such as had been derived from the Arabians. At the conquest of Constantinople by the Turks, about the middle of the fifteenth century, several of the Greeks fled into Italy, and the people of Europe communicating with them, found them to be intelligent, and some of them even learned men. The Europeans were thence led to study the Greek language, in order to read the valuable

book

books which these fugitives had so much extolled; and among other works, those of Galen particularly attracted the notice of the physicians, which, to their great astonishment, contained all the medical knowledge that had been attributed to the Arabians. To the Greek writers, therefore, the physicians of those times closely applied their attention, thinking these books the only true fountains of medical knowledge; and thus it was that the Galenical doctrines became prevalent all over Europe. Early, indeed, in the sixteenth century, the noted Paracelsus had laid the foundation of a chemical system which was in direct opposition to that of Galen; and, by the efficacy of the medicines employed by Paracelsus and his followers, his system came to be received by many: but the orthodox physicians continued to be chiefly Galenists, and kept possession of the schools till the middle of the seventeenth century. It is not, however, necessary here to enter into any further detail respecting the fate of those two opposite sects *; for the only circumstance concerning them, which I would wish at present to point out, is, that in the writings of both, the explanations they severally attempted to give of the phenomena of health or sickness, turned very entirely upon the state of the fluids of the body.

* This will be treated of when we come to give the progress of chemistry. Vide Sect. II. of this Volume.

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Whoever ſearches into the annals of phyſic, cannot fail of being aſtoniſhed at the almoſt infinite variety of ſyſtems and hypotheſes, which at different times have been obtruded on the world. The amazing fertility of the imagination is there diſplayed in its full extent; and perhaps ſo ample an exhibition of the powers of human invention might gratify the vanity of man, if the agreeable effect were not more than counterbalanced by the humbling view of ſo much abſurdity, contradiction, and falſehood. The idleſt opinions have had their abettors; the moſt groundleſs fictions have been ſwallowed with credulity. A liſt of all the follies which, at different periods, have been eſtabliſhed as articles of faith in medicine, would form the ſevereſt ſatire on the healing art. Who can withhold his laughter when he reads of expelling, attracting, and concocting faculties; of energies, ſympathies, antipathies, idioſyncraſies, and occult cauſes; of the body being nothing but ſalt, ſulphur, and mercury; of man being a microcoſm, and uniting in his frame the motion of the ſtars, the nature of the earth, of water, air, all vegetables and minerals, the conſtellations, and the four winds. Yet ridiculous as theſe ſeveral tenets may appear, they have given riſe to ſects, have been eſpouſed with warmth, and defended with acrimony. But the eccentric genius of the theoriſt has not been confined within the limits of phyſiology, and the laws of the animal œconomy: the hidden cauſes

of

of diseases, the elements or first principles of medicines, and their secret mode of action on the body, have afforded another no less extensive field for the exercise of his creative imagination. The bare recital of their several fictions would sufficiently demonstrate their absurdity. But to enumerate them would be an almost endless task. Erasistratus defines disease to be a translation of blood from the veins to the arteries; whereas Galen asserts that, as health consists in the equilibrium between dryness and moisture, heat and cold, sickness must depend upon the subversion of that equilibrium. One sect adopts plethora as the cause of all diseases; another denies the possibility of its existence in the body. Sylvius exults in the discovery that an acid is the sole morbid principle; his antagonists ascribe that honour to their alkali. Salt, sulphur, acrimonies, caustics, volatiles, ferments, &c. &c. have each, at different times and by different systematics, been received as the undoubted *principia morborum.* No less absurd are the fictions of the theorists, concerning the elements and qualities of medicines, and their operation on the body. The same drug is represented as hot in one degree and cold in another, or as dry in one proportion and moist in another. Certain remedies are whimsically assigned to particular parts of the body, on which they are supposed to exert their effects by a peculiar predilection. Hence the classes of pectorals, stomachics, hepatics, cephalics, cordials, &c.

One

One medicine attracts and eliminates the bile another the *pituita*, and a third the *atra bilis* or melancholy. Some preparations *irradiate* the animal spirits, others *darken* and *obscure* them. But enough of these idle conceits, the offspring of theory, and the disgrace of physic!

At length SYDENHAM appeared, who adopted the plan of Hippocrates. At this time the theory of all fevers being an effort to concoct and throw out what was injurious to the frame, was almost universal. Hence it became a *desideratum*, to expel this unknown enemy out of the system; and as it was observed, that acute distempers are sometimes terminated by a critical sweat, it was concluded, that the most powerful sudorifics were the best means of accomplishing this desirable end. This gave rise to the destructive and fatal practice, which was universal, of administering heating remedies, in diseases of an inflammatory nature; a practice productive of great devastation amongst the inhabitants of Europe. Sydenham, the true English Hippocrates, was the first physician who had understanding and courage enough, to stem the rapid and overwhelming torrent: and we are now at last taught, by sad experience, founded on the destruction of numbers of our fellow creatures, that the cooling regimen is alone to be employed in such distempers. The small-pox affords us a remarkable example of the opposite effects of the two different methods of treatment.

And the amazing ſucceſs which has attended the new mode of inoculation, is a proof undeniably convincing, of the excellence and ſafety of the one, and of the danger and frequent fatality of the other. So powerful is the action of heating remedies, in this diſorder, that a ſingle glaſs of mountain wine, given even after the eruption is completed, has produced an additional number of puſtules.

Such was the ſtate of the ſcience of phyſic till about the middle of the ſeventeenth century, when the circulation of the blood came to be generally known and admitted; and this, together with the diſcovery of the receptacle of the chyle, and of the thoracic duct, finally exploded many errors in phyſic. About this period, a conſiderable revolution had taken place in the ſyſtem of Natural Philoſophy. In the courſe of the ſeventeenth century, Galileo had introduced mathematical reaſoning; and Lord Bacon having propoſed the method of induction, had thereby excited a diſpoſition to obſerve facts, and to make experiments. Theſe new modes of philoſophiſing, it might be ſuppoſed, would ſoon have had ſome influence on the ſtate of medicine; but the progreſs of this was ſlow. The knowledge of the circulation did indeed neceſſarily lead to the conſideration as well as to a clearer view of the organic ſyſtem in animal bodies; which led to the application of the mechanical philoſophy to-

wards

wards explaining the phenomena of the animal economy; and it was applied accordingly, and continued till very lately, to be the fashionable mode of reasoning on the subject.

With this view it may be remarked, that, till the period just now mentioned, every physician, whether Galenist or Chemist, had been so much accustomed to consider the state and condition of the fluids, both as the cause of disease, and as the foundation for explaining the operation of medicines, that what we may term an *Humoral Pathology* still continued to make a great part of every system. In these circumstances it was soon perceived, that chemistry promised a much better explanation than the Galenic philosophy had done; and, therefore, while the latter was entirely laid aside, a chemical reasoning was every where received. Lord Bacon, with his usual sagacity, had early observed, that chemistry promised a great harvest of facts, and he therefore gave it credit; whilst the Corpuscularian philosophy, restored by Gassendi, readily united with the reasonings of the chemists; and the philosophy of Des Cartes readily united with both. From all these circumstances, an Humoral and Chemical Pathology came to prevail very much till the end of the last century; and has indeed continued to have a great share in our systems down to the present time.

It is proper now, however, to observe, that about the beginning of the present century, when every part of science came to be on a more improved and correct footing, there appeared in the writings of STAHL, of HOFFMAN, and of BOERHAAVE, three new, and considerably different, Systems of Physic; which have ever since had a great share in directing the practice of it. In order, therefore, to give a nearer view of the present state of physic, I shall offer some remarks upon these different systems, endeavouring to point out the advantages as well as the disadvantages of each, and how far they still prevail; or, according to my judgment, deserve to do so.

Theories of Stahl, Hoffman, and Boerhaave.

I shall begin with considering that of Dr. Stahl, which I think appeared first, and for a long time after was the prevailing system in Germany.

Stahl's system of physic.

The chief and leading principle of this system is, that the *rational soul* of man governs the whole œconomy of his body. At all times, physicians have observed, that the animal œconomy has in itself a power or condition, by which, in many instances, it resists the injuries which threaten it; and by which it also, on many occasions, corrects or removes the disorders induced, or arising in it. This power, physicians very anciently attributed, under a vague idea, to an agent in the system,

which

which they called nature; and the language of a *vis confervatrix et medicatrix naturæ*, has continued in the fchools of medicine from the moft ancient times to the prefent.

Dr. Stahl has explicitly founded his fyftem on the fuppofition, that the power of nature, fo much talked of, is entirely in the rational foul. He fuppofes, that, upon many occafions, the foul acts independently of the ftate of the body; and that, without any phyfical neceffity arifing from that ftate, the foul, purely in confequence of its intelligence, perceiving the tendency of noxious powers threatening, or of diforders anywife arifing in the fyftem, immediately excites fuch motions in the body as are fuited to obviate the hurtful or pernicious confequences which might otherwife take place. By means of the nerves, the influence of the mind is extended to every part of the fyftem, and if their action be impeded, difeafe is the unavoidable confequence. A fuperabundance and fpiffitude of the blood is therefore the proximate caufe of ficknefs, as the energy of the mind is thereby diminifhed, and its action on the body obftructed. Hence to leffen the quantity, and break down the *lentor* of the blood, the foul exerts all its powers, and excites hemorrhages, fweats, diarrhœas, fevers, and the like. Many of my readers may think it was hardly neceffary for me to take notice of a fyftem founded upon fo fanciful an hypothefis: but there is often fo much learning

appearance of intelligence and defign in the operations of the animal œconomy, that many eminent perfons, as Perault in France, Gaubius in Holland, Porterfield and Simfon in Scotland, and Nichols in England, have very much countenanced the fame opinion, and it is therefore certainly entitled to fome regard. Dr. Porterfield and Dr. Nichols have carried this theory ftill further. The latter, in his *prælection de anima medica*, affirms without referve, that the foul at firft forms the body, and afterwards governs it; that fhe regulates and conducts all its vital and natural motions; circulates the fluids and diftributes them to the different parts of the fyftem, with fuch velocity and in fuch proportion as fhe judges right; and that whenever the body is difordered, fhe excites thofe conflicts and commotions, which are beft adapted to reftore it to health and foundnefs. It is not, however, neceffary for me here to enter into a long confutation of this doctrine, I fhall therefore only add now, that whoever confiders what has been faid by Dr. Nichols in his *oratio de anima medica*, and by Dr. Gaubius in fome parts of his pathology, muft perceive, that the admitting of fuch a capricious government of the animal œconomy, as thefe authors are inclined to fuppofe, would at once lead us to reject all the phyfical and mechanical reafoning we might employ concerning the human body. Both Dr. Stahl and his followers have been very much

much governed by this ſuppoſition. Truſting much to the conſtant attention and wiſdom of nature, they have propoſed the *Art of curing by expectation*; have therefore, for the moſt part, propoſed only very inert and frivolous remedies; have zealouſly oppoſed the uſe of ſome of the moſt efficacious, ſuch as opium and the Peruvian bark; and are extremely reſerved in the uſe of general remedies, ſuch as bleeding, vomiting, &c.

Although theſe remarks, upon a ſyſtem which may now be conſidered as exploded or neglected, may ſeem ſuperfluous; I have been willing to give theſe ſtrictures on the Stahlian ſyſtem, that I might carry my remarks a little farther, and take this opportunity of obſerving, that, in whatever manner we may explain what have been called the operations of nature, it appears to me, that the general doctrine of *Nature curing diſeaſes*, the ſo much vaunted *Hippocratic* method of curing, has often had a very baneful influence on the practice of phyſic; as either leading phyſicians into, or continuing them in, a weak and feeble practice; and at the ſame time ſuperſeding or diſcouraging the proper attempts of art. Dr. Huxham has obſerved, that even in the hands of Sydenham it had this effect. And although it may ſometimes avoid the miſchiefs of bold and raſh practitioners, yet it certainly produces that caution and timidity which have ever oppoſed the introduction of new and efficacious remedies. I might

go farther, and ſhew how much the attention to the *Autocrateia*, allowed of, in one ſhape or other, by every ſect, has corrupted the practice among all phyſicians, from Hippocrates to Stahl. It muſt, however, be ſufficiently obvious, and I ſhall conclude the ſubject with obſerving, that although the *vis medicatrix naturæ* muſt undoubtedly be received as a fact; yet, it throws an obſcurity upon a ſyſtem of phyſic; and we ought rarely to admit of it in our practice.

To finiſh our remarks upon the Stahlian ſyſtem, I ſhall ſhortly obſerve, that it did not depend entirely upon the *Autocrateia*, but alſo ſuppoſed a ſtate of the body and diſeaſes, that admitted of remedies, which under the power and direction of the ſoul, acted upon the organization and matter of the body, ſo as to cure its diſeaſes. Upon this footing, the Stahlian pathology turned entirely upon *Plethora* and *Cacochymy* *. It was with reſpect to the former that they eſpecially applied their doctrine of the *Autocrateia* in a very fanciful manner; and, with reſpect to the latter, they have been involved in an humoral pathology as much as the ſyſtematic phyſicians who had gone before them, and with a theory ſo incorrect as not to merit now the ſmalleſt attention. After all, I ought not to diſmiſs the conſideration of the Stahlian ſyſtem, without remarking, that as the fol-

* A depraved ſtate of the fluids.

lowers of this syſtem were very intent upon obſerving the method of nature, ſo they were very attentive in obſerving the phenomena of diſeaſes, and have given us in their writings many facts not to be found elſewhere.

Hoffman's ſyſtem of phyſic.

While the doctrines of Stahl were prevailing in the univerſity of Halle, Dr. HOFFMAN, a profeſſor in the ſame univerſity, propoſed a ſyſtem that was very different. Frederick Hoffman was born at Hall, in the year 1660. He graduated in phyſic in 1681, was made profeſſor of phyſic there in 1733, and filled that chair till his death in 1742. A very remarkable circumſtance of his life is, that he never took fees from his patients, but was content with his ſtipend. He was in high repute as a practitioner, and curing the Emperor Charles VI. and Empreſs, and Frederick I. of Pruſſia, of inveterate diſeaſes, greatly increaſed his reputation. His works are collected in ſix volumes folio, publiſhed at different times from 1748 to 1754. They abound with many uſeful practical directions; but at the ſame time contain many frivolous remarks, and an abundance of frivolous conjectural theory. He received into his ſyſtem a great deal of the mechanical, Carteſian, and chemical doctrines of the ſyſtems which had appeared before: but, with reſpect to theſe, it is of no conſequence to obſerve in what manner he modified the doctrines of his predeceſſors, as his improvements in theſe reſpects were nowiſe con-

 ſiderable,

fiderable, and no part of them now remain; and the real value of his works, beyond what I am just now going to mention, refts entirely on the many facts they contain. However, the great merit of Dr. Hoffman's work is, that he made, or rather fuggefted, the idea of *fpafm*, which highly deferves our attention.

There can be no fort of doubt, fays Dr. Cullen, that the phenomena of the animal œconomy, in health and in ficknefs, can only be explained by confidering the ftate and affections of the primary moving powers in it. It is to me furprifing that phyficians were fo long in perceiving this, and I think we are therefore particularly indebted to Dr. Hoffman for putting us into the proper train of inveftigation; and it every day appears that phyficians perceive the neceffity of entering more and more into this inquiry.

It was this, I think, which engaged the learned Dr. Boerhaave to publifh his work intitled *Impetum faciens*; as well as Dr. Gaubius to give the pathology of the *Solidum vivum*. Even the Baron Van Swieten, who has written a commentary upon Boerhaave, has, upon the fame view, thought it neceffary, in at leaft one particular, to make a very confiderable change in the doctrine of his mafter, as he has done in his commentary upon the 755th Aphorifm. In thefe, and in many other inftances, particularly in the writings of Mr. Barthez of Montpelier, we fee a vaft progrefs

made in the ſtudy of the affections of the Nervous Syſtem, and cannot fail to perceive how much we are indebted to Dr. Hoffman for his ſo properly beginning it. The ſubject, however, is difficult: the laws of the Nervous Syſtem, in the various circumſtances of the animal œconomy, are by no means aſcertained; and, from want of attention and obſervation with the view to a ſyſtem on this ſubject, the whole muſt appear to many as an inexplicable myſtery. There is no wonder, therefore, that, on ſuch a difficult ſubject, Dr. Hoffman's ſyſtem was imperfect and incorrect; and has had leſs influence on the writings and practice of phyſicians ſince his time than might have been expected. He himſelf has not applied his fundamental doctrine ſo extenſively as he might have done; and he has every where intermixed an *Humoral Pathology*, as incorrect and hypothetical as any other. Though he differed from his colleague Dr. Stahl in the fundamental doctrines of his ſyſtem, it is but too evident that he was very much infected with the Stahlian doctrines of *Plethora* and *Cacochymy*, as may be obſerved throughout the whole courſe of his work; and particularly in his chapter *De Morborum generatione ex nimia ſanguinis quantitate, et humorum impuritate.*

But it is needleſs for me to dwell any longer upon the ſyſtem of Hoffman's and I am next to offer ſome remarks on the ſyſtem of Dr. Boerhaave,

haave, the cotemporary of both the other Systematics, and who, over all Europe, and especially in this part of the world, gained higher reputation than any others.

Dr. Boerhaave was a man of general erudition; and in applying to medicine, he had carefully studied the auxiliary branches of anatomy, chemistry, and botany, so that he excelled in each. Voorhoot, a small village about two miles from Leyden, gave birth to this eminent physician on the last day of the year 1668. He was educated at Leyden, and took his first degree in philosophy in 1690. His thesis on this occasion was a confutation of the doctrines of Epicurus, Hobbes, and Spinosa, in which he shewed great strength of genius and argument. Although he was at this time well qualified to enter into the church, which was his father's intention, yet he was diffident of his abilities, and chose to attend the lectures of divinity some time longer. His patrimony was exhausted, and he supported himself at the university by teaching mathematics, while he prosecuted his theological studies. This conduct was much approved by the eminent men both of the university and city, and procured for Boerhaave the friendship of Mr. Vandenburg the burgomaster of Leyden. Under the patronage, and at the persuasion of this gentleman, Boerhaave applied himself to the study of physic with great ardour and indefatigable diligence. In a short time he became

became a proficient in anatomy, chemiſtry, and the materia medica, which indeed are the baſes of phyſic. Leaving Leyden, he went to the univerſity of Harderwick in Guelderland, and there took his degree of Doctor of Phyſic in July 1693. On his return to Leyden he ſtill perſiſted in his intention of entering into the miniſtry, which, luckily for the ſake of phyſic, was fruſtrated by the following adventure. In a paſſage boat where Boerhaave was, a diſcourſe was accidentally ſtarted about the doctrines of Spinoſa, as ſubverſive of religion; and one of the paſſengers, with vague invectives of blind zeal, oppoſed this philoſopher's pretended mathematical demonſtration. Boerhaave calmly aſked him if he had read Spinoſa's work, which he had ſo much derided. The bigot was ſuddenly ſtruck dumb, and became fired with ſilent reſentment. As ſoon as he arrived at Leyden, he ſpread abroad a rumour that Boerhaave was become a Spinoſiſt. Boerhaave finding theſe prejudices to gain ground, thought it more prudent to purſue the ſcience of phyſic, than riſk the refuſal of a licence for the pulpit. He now joined the practice of phyſic to the theory. On the 18th of May 1701 he commenced his lectures on the Inſtitutes of Phyſic. In 1709 he was created Profeſſor of Medicine and Botany; and in 1718 he ſucceeded Le Mort in the Profeſſorſhip of Chemiſtry. In forming a Syſtem of Phyſic, he ſeems to have ſtudied diligently all the ſeveral writings of both ancient

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and modern phyſicians; and, without prejudice in favour of any former ſyſtems, he endeavoured to be a candid and genuine ecclectic *. Poſſeſſed of an excellent ſyſtematic genius, he gave a ſyſtem ſuperior to any that had ever before appeared. As in the great extent, and ſeemingly perfect conſiſtency, of ſyſtem, he appeared to improve and refine upon every thing that had before been offered; and as in his lectures he explained his doctrines with great clearneſs and elegance, he ſoon acquired a very high reputation, and his doctrines were more generally received than any former had been ſince the time of Galen. Whoever will conſider the merits of Dr. Boerhaave, and can compare his ſyſtem with that of former writers, muſt acknowledge that he was very juſtly eſteemed, and gave a ſyſtem which was at that time deſervedly valued.

But, in the progreſs of an inquiſitive and induſtrious age, it was not to be expected that any ſyſtem ſhould laſt ſo long as Boerhaave's has done. The elaborate Commentary of Van Swieten on Boerhaave's ſyſtem of phyſic, has been only finiſhed a few years ago; and though this commentator has added many facts, and made ſome corrections, he has not, except in the particular mentioned above, made any improvement. It is even ſurpriſing that Boerhaave himſelf, though he lived near forty years after he had firſt

* That is, chuſing whatever is good out of every ſyſtem.

formed

form[illegible] system, had hardly, in all that time made [illegible]rrections of it, or additions to it.

Wh[illegible] first applied, says Cullen, to the study of physic, I learned only the system of Boerhaave; and even when I came to take a Professor's chair in this university, I found that system here in its entire and full force; and as I believe it still subsists in credit elsewhere, and that no other system of reputation has been yet offered to the world, I think it nece[illegible]ry for me to point out particularly the imperfe[illegible]ons and deficiencies of the Boerhaavian syste[illegible] in order to shew the propriety and necessity of a[illegible]empting a new one.

Dr. Boerhaave's treatise of the diseases of the simple solids, has the appearance of being very clear and consistent, and was certainly considered by him as a fundamental doctrine: but, in my apprehension, it is neither correct nor extensively applicable. Not to mention the useless, and perhaps erroneous, notion of the composition of earth and gluten; nor his mistake concerning the structure of compound membranes; nor his inattention to the state of the cellular texture; all of them circumstances which render his doctrine imperfect; I shall insist only upon the whole being very little applicable to the explaining the phenomena of health or sickness. The laxity or rigidity of the simple solid does indeed take place [illegible] the different periods of life, and may per[illegible] upon other occasions, occur as the cau[illegible]ples,

[illegible]mercury

case: but I presume, that the state of the simple solid is, upon few occasions, either changeable or actually changed; and that, in ninety-nine cases of an hundred, the phenomena attributed to such a change, do truly depend on the state of the *living solid*; a circumstance which Dr. Boerhaave has hardly taken notice of in any part of his works. How much this shews the deficiency and imperfection of his system I need not explain. The learned work of Dr. Gaubius, above referred to, as well as many other treatises of late authors, point out sufficiently the defects and imperfections of Boerhaave on this subject. If we consider the imperfection of Dr. Boerhaave's doctrine with respect to the state and various condition of the animal fluids; and if at the same time we reflect how frequently he and his followers have employed the supposition of an *acrimony* or *lentor* of the fluids, as causes of disease, and for directing the practice; we must, as I apprehend, be satisfied, that his system is not only deficient and incomplete, but fallacious and apt to mislead. Although it cannot be denied, that the fluids of the human body suffer various morbid changes, and that upon these, diseases may primarily depend; yet I must beg leave to maintain, that the

is nature of these changes was not at that time un-

though understood: that our reasonings therefore concern-

them have been, for the most part, purely

* That is, chimerical; and have therefore contributed nothing

thing to improve, and have often misled, the practice of physic. In this, particularly, they have been hurtful, having withdrawn our attention from, and prevented our study of, the *motions* of the animal system, upon the state of which the phenomena of diseases do more certainly and generally depend. Whoever, then, shall consider the almost total neglect of the state of the moving powers of the animal body, and the prevalence of an hypothetical *humoral pathology*, so conspicuous in every part of the Boerhaavian System, must be convinced of its very great defects, and perceive the necessity of attempting one more correct *.

The body according to Boerhaave is chiefly composed of a conic, elastic, inflected canal, divided into similar lesser ones proceeding from the same trunk, which being at last collected into a retiform contexture, mutually open into each other, and send off two orders of vessels, lympathics and veins, the one terminating in different cavities of the body, the other in the heart. These tubes are destined for the conveyance of the animal fluids; in the circulation of which life consists, and on whose free and undisturbed motion health depends. *Obstruction* therefore is the proximate cause of most diseases. And as it is produced either by a constriction of the vessels,

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* From Cullen's preface to his Practice of Phy

les,

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or by a *lentor* in the blood, these are considered as the remote causes.

However plausible this theory may appear to be at first sight, it will be found, on a stricter examination, to be fallacious and defective. The mathematician, who calculates the projectile force of the heart, the velocity of the blood in the arteries, and the various secretions of the glands, from the known laws of fluids in motion, and the nature of tubes of different shapes and sizes, must unavoidably be exposed to a thousand mistakes. The vessels of the body are too numerous and minute to admit of an accurate mensuration; and they are perhaps every moment undergoing changes from the diversified action of that *vital power* which animates our wonderful system. Hence arises the contrariety in the computations of philosophers on this subject. Borelli reckons the resistance which the heart overcomes, in propelling the blood through the arteries and veins, to be equal to 180,000 pounds weight; Dr. Hales makes it amount to no more than 51 pounds; and Keil, though he computes the fluids of the human body to be five times more in quantity than Borelli supposes, hath reduced the sum to a single pound. One asserts that the pressure of air, overcome in ordinary respiration, is equivalent to the weight of 14000 pounds; a second [illegible]s it to be equal only to a 100 pounds; and [illegible]akes it so inconsiderable, as to be almost below

* That is, [illegible]

below comparifon; whilft all the three appeal to mathematical demonftration. A fimilar diverfity appears in the conclufions of the mathematicians, concerning the quantity of bile feparated by the liver. To determine this point, Borelli firft meafures the diameter of the *ductus communis choledochus*, which he finds to be the 225th part of the diameter of the *vena cava*, juft before it enters the right auricle of the heart. Hence he infers that if 7680 pounds of blood (fuppofing the whole mafs to be twenty pounds, and to circulate fixteen times every hour) paffes through the *vena cava* in twenty-four hours, the 225th part of this quantity, *i. e.* thirty-four pounds of bile, muft, in the fame fpace of time, be tranfmitted through the hepatic ducts: a conclufion altogether repugnant to fact and experience. And it will appear to be much more fo, if we admit, with the latter mathematicians, that the veffels of the human body contain at a medium thirty pounds of blood; for then the quantity of bile, according to Borelli's method of reafoning, muft amount to eighty-five pounds in one day. But in this, as in the former inftance, Keil widely differs from Borelli, and with greater probability concludes, that two drachms of bile, and no more, are hourly feparated from the liver. In thefe calculations no attention is paid to the peculiar nature of the animal fluids. Water and wine, a poifonous and wholefome liquid, are governed by the fame hydraulic [illegible]ples, [illegible]nercury

but their effects when circulating in the body would certainly be very different. We know from experience, that the velocity of the pulse is influenced by the state of the blood. Even the accession of new chyle, after each meal, quickens the action of the heart and arteries. The human body therefore is not to be considered as a mere machine; and that theory which is built on this foundation is evidently fallacious *.

And the mechanic hypothesis is also inadequate and defective; for the animal frame is incident to numberless diseases which have no dependence on obstruction. The *morbi fibræ debilis et laxæ* could not, even by Boerhaave himself, be ascribed to this cause. The dropsy, scurvy, putrid fevers, small-pox, measles, &c. are inexplicable on mechanical principles. A numerous class of diseases also depend upon the sympathetic connexion, which subsists between different parts of the body. When the stomach is out of order, languor, debility, watchfulness, the night mare, and sometimes a *cephalæa*, *vertigo*, or *hemicrania*, are the consequences. A rough bone stimulating

* In the Philosophical Transactions there is a table, in which the several purgatives and emetics commonly in use are enumerated and adjusted by mathematical rules, to all ages, sexes, and constitutions. The doses of the medicines are as the squares of the constitutions. And in the Edinburgh Medical Essays there is a formal attempt to correct the errors of this table!

the nerves of the great toe, hath produced epileptic fits. And it is well known that children, from the irritation of the gums in dentition, are liable to vomiting, purging, fever, and convulsions. These few instances are sufficient to shew that the body is unhappily subject to many disorders, besides those which proceed from *obstruction*. And perhaps the conclusion may be carried still further, when we consider that in the operation for the aneurism a large artery is tied up, and the circulation of the blood for some time almost totally suppressed in the part, without any material injury to health. Morgagni relates that Valsalva* affixed two ligatures to the carotids of a dog, who lived above twenty days after the operation, and might have continued longer, if he had not been killed for the purpose of dissection. Is it then to be supposed that the obstruction of a few capillaries, which are united together by an infinite number of anastomosing branches, can be productive of such fatal consequences, whilst the course of the blood is stopped in large vessels with impunity? Equally false and absurd is the mechanical hypothesis, concerning the operation of medicines, which is supposed to depend upon the size, figure, and gravity of their constituent particles. Thus chalybeates, for example, were recommended in obstructions on account of the *momentum* which they were thought to communicate to the blood. And on the same principles,

mercury was ſaid to break down the texture, and produce a colliquation of the animal fluids. But both theſe explanations, however beautiful in theory, are untrue; for, from the experiments of Girtanner *, it is evident, that they act in proportion to the *oxygen* they contain. And it is ſurely beyond the bounds of credibility to ſuppoſe, that a few grains of corroſive ſublimate, which are light enough to be ſuſpended and diſſolved in brandy, are capable, by their *extraordinary weight*, of diſſolving the *craſſamentum* of the blood. But it is the genius of theory to dignify trifles, and to aſcribe the moſt wonderful effects to the moſt inſignificant cauſes.

Happy however had it been for the world, if the medical ſyſtems, which have been obtruded on it, were only chargeable with inutility, abſurdity, or falſehood. But alas! they have often miſled the underſtanding, perverted the judgment, and given riſe to the moſt dangerous and fatal errors in practice. A ſhort view of the hiſtory of phyſic will convince us of this melancholy truth.

As long as Philosophy was built, not upon the ſubſtantial baſis of actual experiment, but imagined properties, which were aſſumed as data, it was putting on new forms almoſt every day;

* Vide Dr. Beddoes' Tranſlation of the Eſſays of Girtanner.

for

for one fanciful opinion had always a right to supplant another. Hence the best PHILOSOPHER in such days was him who could reason most ingeniously on occult qualities, either invented by himself, or by some favourite writer.

Lord Chancellor Bacon was the first who discovered the fallacy of this sort of philosophy. He rejected all that chimerical nonsense, which had usurped the name of philosophy, and wisely exclaimed—"Non fingendum, aut excogitan-"dum, quid Natura feret et faciat, sed invenien-"dum est." That the operations of nature was not to be fancied, but diligently scrutinized. Hence, in less than the space of a century, the principle of philosophizing being altered, more light was thrown upon every branch of science, than it had received for above two thousand years before.

The discovery of the *circulation of the blood* first immortalized the name of HARVEY. It may appear wonderful, and at the same time not a little mortifying to the vanity of mankind, that a motion in the frame, which constitutes the basis of life, and which chance must have made us sensible of a thousand times, should have escaped the eyes of all who imagined themselves to be observers, and some of whom were actually such. When the doctrine of the circulation of the blood could no longer be resisted, various unsuccessful attempts were then made to prove that it was known long before; *Harvey's discovery of the circulation of the blood.*

 so

ſo was it with Columbus who diſcovered a new world, which occaſioned him to make this ſimple propoſal to his oppoſers, namely, "*to place an egg* "*upright.*" All attempted, but in vain. This illuſtrious navigator then *himſelf* broke the end, and "*the egg ſtood up.*" "*The thing,*" ſays he, "*is very eaſy when known,*" and ENVY itſelf was abaſhed. Thus attraction, the weight, and elaſticity of the air, ſhewed themſelves to the ſenſes every day; but it required a Torricelli and a Newton to illuſtrate them.

Haller's diſcovery of the irritability of the fibre.

The next diſcovery of importance was the cauſe of this motion of the vaſcular ſyſtem, by the illuſtrious Baron DE HALLER, who found it to ariſe from the ſtimulus of blood acting upon the *irritable principle* of the fibre. This uſeful diſcovery, like the former, excited the venom of a long oppoſition, and although founded upon *experiments*, was alike diſbelieved, and when accredited, others were called in to participate in the honour.

THE DISCOVERIES OF BARON DE HALLER.

Fables relate that Venus was wedded to Vulcan, the Goddeſs of beauty to the God of deformity. The tale, as ſome explain it, gives a double repreſentation of art; Vulcan ſhewing us the *progreſſions* of art, and Venus the *completions*. The *progreſſions*, ſuch as the hewing of ſtone, the grinding of colours, the fuſion of metals, theſe all of them are laborious, and many times diſguſtful: the *completions*, ſuch as the temple, the palace, the picture, the ſtatue, theſe all of them are beauties, and juſtly call for admiration. Now if *Anatomy* and *Phyſiology* be arts not ending in themſelves, but have a view to ſomething farther, they muſt neceſſarily be arts of the *progreſſive character*. If then, in treating on them, the ſubject ſhould appear *dry* rather than *elegant*, *ſevere* rather than *pleaſing*, let it plead, by way of defence, that, though its importance may be great, it partakes from its very nature, which cannot be changed, more of the *deformed God*, than of the *beautiful Goddeſs*.

Harris.

I. OF IRRITABLE PARTS.

Irritability is one of thoſe grand truths which is undeniably demonſtrated; and *Poſterity*, which alone ſtamps the merit of diſcoveries, *by abſtracting of perſons*, will promote *this diſcovery* to that rank, which its usefulness entitles it to.

 She

She will laugh when ſhe obſerves, that after its oppoſers had failed in perſuading us there was *no ſuch thing*, they ſhould endeavour to render the doctrine *odious*, by the conſequence which they pretend naturally follows from it. She will be diverted to ſee Phyſicians following the example of religious Sectaries and Devotees, intereſting the cauſe of GOD with *theirs*, and accuſing of *materialiſm*, ſuch as differ from them in opinion as to the pulſations of the Heart, and motion of the other organs. A certain author, well known for the greatneſs of his talents, and the bad uſe which he made of them, has endeavoured to draw *this induction*; but the illuſtrious De Haller, who was ſeriouſly affected at the imputation, has ably refuted the futility of ſuch impious and abſurd reaſoning.

The Heart. It is obſervable, that the motion of the HEART not only ſurvives that of the organs of voluntary motion, but continues a conſiderable time even after it is ſeparated from the body. Nay, after it has even ceaſed to palpitate, yet as it ſtill retains a latent power of contraction, its ſyſtole and diaſtole may, by the application of ſtimuli, be alternately renewed and continued ſome time longer. Hence in drowning or ſuffocation, though the pulſe be imperceptible, and life apparently extinguiſhed, yet the heart ſtill preſerves this latent power or ſuſceptibility of motion; for though unable to propel the blood through

through the vaſcular ſyſtem, yet it wants only to be gently excited by ſuitable ſtimuli to renew its action.

In the firſt rudiments of animal life, even before the brain is formed, the *punctum ſaliens* points out the embrio heart in miniature, and marks its *primæval irritability* as a ſure preſage of vitality.

The heart of the chick begins to move, before we dare preſume, that there is any organ for diſtributing the nervous power. The *punctum ſaliens*, is the heart of the chick; it is ſeen beating while the body of the chick is but a rude, unformed, and gelatinous maſs.

As this ſingular organ exhibits *irritability* the firſt, ſo it never relinquiſhes it till the laſt, and may therefore be conſidered as the *primum mobile* and *ultimum moriens* of the animal machine.

In animals with cold blood the *irritability* is very great, and continues a long while. The heart of a *viper* will palpitate when taken from its body twenty-four hours, and that of a *turtle* thirty or longer; and in animals whoſe blood is hot, it moves until the fat is rendered ſtiff by the cold, at which time the motions of the heart and all the other muſcles commonly ceaſe.

The celebrated Boerhaave acknowledges an active force in the *heart*, and a latent principle of motion in the pieces of it when cut, but he

nevertheless attributes this to the *nerves*, though the communication with the brain has been cut off! Dr. Whytt follows the same path, but with this difference of expression, he uses the term *irritability*, and imputes it to the *soul*, which feeling the impression of the *irritation* occasions the contraction of the fibre, the *soul* therefore with him is *devisible*, and resides in *every living part* of the body! Accordingly we find also, in other books, "All motion is owing to the *soul*, which "being sensible of stimuli contracts the fibres "which are touched, and pulls them back, to pre-"vent their being injured *."

However simple this theory may be, and, like the doctrine of *Phlogiston* among the chemists, however *commodious* for disembarrassing us from several difficulties, yet as it is not in unison with the phænomena that are observed, it must be rejected.

1. For, in the *first place*, the most *irritable parts* are those that are *least sensible*, and therefore not subject to the command of the soul, which ought to be quite the reverse, if the *soul* was the principle of *irritability*.

2. In the *second place*, *irritability* continues *after death*, and in parts quite *separated* from the body, and *deprived* of its *communication with the*

* This is the *Vis Medicatrix* of the old Physicians.

brain,

brain *, for there is nothing more common than to ſee the heart of a frog beat, and the muſcles remain irritable, after the head has been taken off, and the ſpinal marrow removed.

3. And *thirdly*, it is generally allowed, that the *nerves* are the organs and the *brain* the receptacle of all our ſenſations, the ſources of all our ideas; but the *nerves* and the *brain*, as will be preſently ſhewn, *are not irritable*, therefore *irritability has nothing in common with ſenſation* †.

MUSCLES are compoſed of longitudinal fibres which ſhorten themſelves, and are ſo diſ- *The Muſcles.*

* The heart is obſerved before the brain in the embrio chick, and is ſuppoſed therefore to act independent of brain. Some children have grown their full period in the womb, where there has been found after birth *no brain*. Might not *irritation* during the fœtal period ſerve all the purpoſes of *this vegetative life?* but as ſoon as the infant is brought into the world, where voluntary motion and ſenſation is required, a ſtate *advanced above the vegetable*, the babe *without a brain* inſtantly periſhes.

† The heart is divided into two *auricles* and two *ventricles*. The *auricles* communicate with their correſponding *ventricles*, and have *valves* to guard this paſſage. The *valves* on the right ſide are called *tricuſpides*, on the left *mitral*. Theſe prevent the recurrence of the blood into the *auricles*. The *auricles* and *ventricles* may be ſaid to be hollow muſcles, or rather may be compared to two hollow cavities on each ſide formed of one muſcle, and the left cavities or muſcles are more abundantly furniſhed with fibres, becauſe a greater force is required to propel the blood through the body than the lungs.

poſed

posed that this contraction always serves some wise purpose. They elegantly terminate in tendons, which are braced by sheaths, and though so numerous, each occupies its proper place and just direction.

Colour was believed to be essential to the constitution of a *Muscle*. But in fowls, in amphibious animals, in fishes, in worms and insects, through all the gradations of animals, of different species, of different sizes, the colours of the muscular fibre change. In fishes, and in insects, it is generally white; even in the human body, it is not essentially red; the fibres of the iris, and the muscular coats of the arteries, the muscles of the stomach, of the intestines, and of the urinary bladder, are colourless. We cannot therefore define a muscle by that property which it often wants; but we may, with the utmost propriety, characterize it by its *contractile power*, the only true evidence of its nature; for the contraction of the iris proves it to be a muscle by truer marks than its colour*; and by the same rule the muscles of a fish, or of the meanest insect, are as perfect as those of man.

* Such is the connexion betwixt muscles and their *contractile force*, or PRINCIPLE of IRRITABILITY, that the moment it dies, all its astonishing power is gone: and the muscle which could lift an hundred pounds while *alive*, can bear the weight but of a few pounds when *dead*. Whereas,

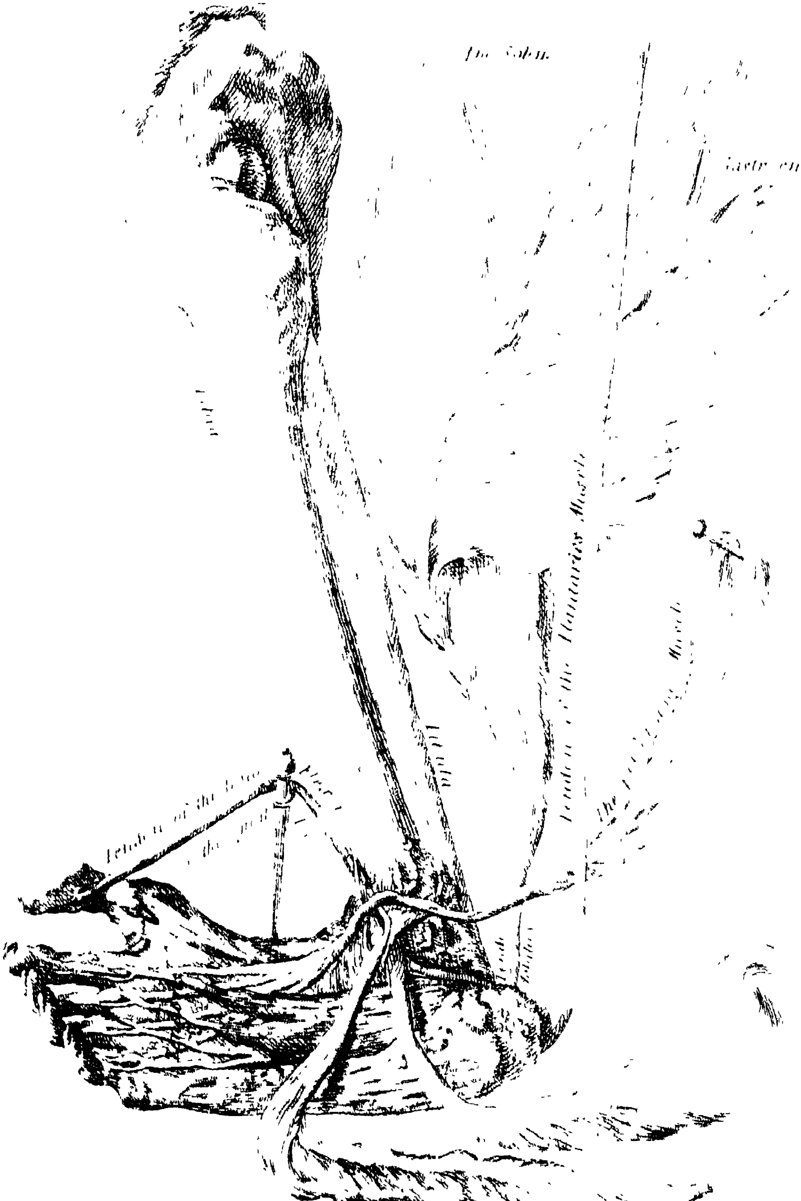


Fig. 1

Whereas, on the contrary, all thoſe parts that are *inirritable*, as the ligaments, tendons, &c. are capable of bearing the ſame weight when *dead* as when *alive*.

This *irritable*, or *contractile power*, in muſcles, is that property by which muſcles recede from certain ſtimuli, without any feeling, without creating any conſciouſneſs of action, and ſo little dependant is it upon nerves, that it is found equally perfect in *animals* * and *plants* which have no nerves, and remains in parts ſevered from the body to which they belong. This *irritability* is ſo far independent of nerves, and ſo little connected with feeling, which is the province of the nerves, that upon ſtimulating any muſcle by touching it with a cauſtic, or irritating it with a ſharp point, or driving the electric ſpark through it, the muſcle inſtantly contracts; although the nerve of that muſcle be tied; although the nerve be cut ſo as to ſeparate the muſcle entirely from all connection with the ſyſtem; although the muſcle itſelf be ſeparated from the body; although the creature upon which it be performed, may have loſt all ſenſe of feeling, and have been long to all appearance dead. Thus a *muſcle* cut from the limb, trembles and palpitates long after: the *heart*, ſeparated from the body, contracts when irritated; the *bowels*, when torn

* The polypus, according to John Hunter, is devoid of nerves.

from the body, continue their periſtaltic motion, ſo as to roll upon the table, ceaſing to anſwer to ſtimuli only when they themſelves become actually dead. Even in *vegetables*, as in the ſenſitive plant, this contractile power lives. It is by this *irritable principle*, that a cut *muſcle* contracts and leaves a gap; that a cut *artery* ſhrinks and retires into the fleſh. Even when the body is dead to all appearance, and the nervous power gone, this contractile power remains; ſo that if a body be placed in certain attitudes, before it be cold, its *muſcles* will contract, and it will be ſtiffened in that poſture till the organization yields, and begins to be diſſolved. Hence comes the diſtinction betwixt the *irritability* of the muſcles and the *ſenſibility* of nerves; for the *irritability* of muſcles ſurvives the animal,—as when it is active after death;—ſurvives the life of the part, or the feeling of the whole ſyſtem, as in palſy, where the vital motions continue entire and perfect;—and where the muſcles, though not obedient to the will, are ſubject to irregular and violent action;—and it ſurvives the connexion with the reſt of the ſyſtem, as where animals very tenacious of life are cut into pieces: whereas *ſenſibility*, the property of the nerves, gives the various modifications of ſenſe, as viſion, hearing, and the reſt; gives alſo the general ſenſe of pleaſure or pain; and thus the eye feels, and the ſkin feels; but their appointed ſtimuli produce

produce *no motions* in theſe parts; they are *ſenſible* but not *irritable*. The *heart*, the *inteſtines*, and all the *muſcles* of voluntary motion, anſwer to ſtimuli with a quick and forcible contraction; and yet they hardly feel the ſtimuli by which theſe contractions are produced, or at leaſt they do not convey that feeling * to the brain. There is no conſciouſneſs of preſent ſtimulus in thoſe parts which are called into action by the impulſe of the nerves, and at the command of the will: ſo that *muſcular parts* have *all the irritability* of the ſyſtem, with but *little feeling*, and that little owing to the nerves which enter their ſubſtance; while *nerves* have *all the ſenſibility* of the ſyſtem, but *no motion*.

The nervous influence is a mere ſtimulus to the voluntary muſcles, as blood is to the heart and arteries; food to the ſtomach; or bile to the inteſtines. It loſes its influence over the ſyſtem ſooner, than the irritable principle in the fibre fails: for the irritable ſtate of the muſcle continues long after the voluntary motion, or power of excitement from the nerves, is gone; for when we die *ſlowly*, the irritable principle of the muſcles is exhauſted in the ſtruggles of death. If, while in perfect health, we are killed by a *ſudden blow*, the irritable power of the

* The cauſe of this curious phænomenon we ſhall particularly explain, when we come to treat of *ganglions*.

muscles survives the nervous system many hours or days, and the flesh trembles, and the absorbents continue to absorb; and often, as after suffocation, or drowning, we can, by operating upon this poor remains of life, restore the circulation, re-animate the nervous system, and recover that life, which seemed to have entirely left the body; and thus the nervous influence, which seemed to animate the system, and to be the prime mover and source of life, owes its restoration to that, which was conceived to be but a secondary power.

There are *some muscles* which have a *stronger contracting force* than *others*, and retain it a longer time after the animal is dead. The chief of these is the DIAPHRAGM *, which I have always observed

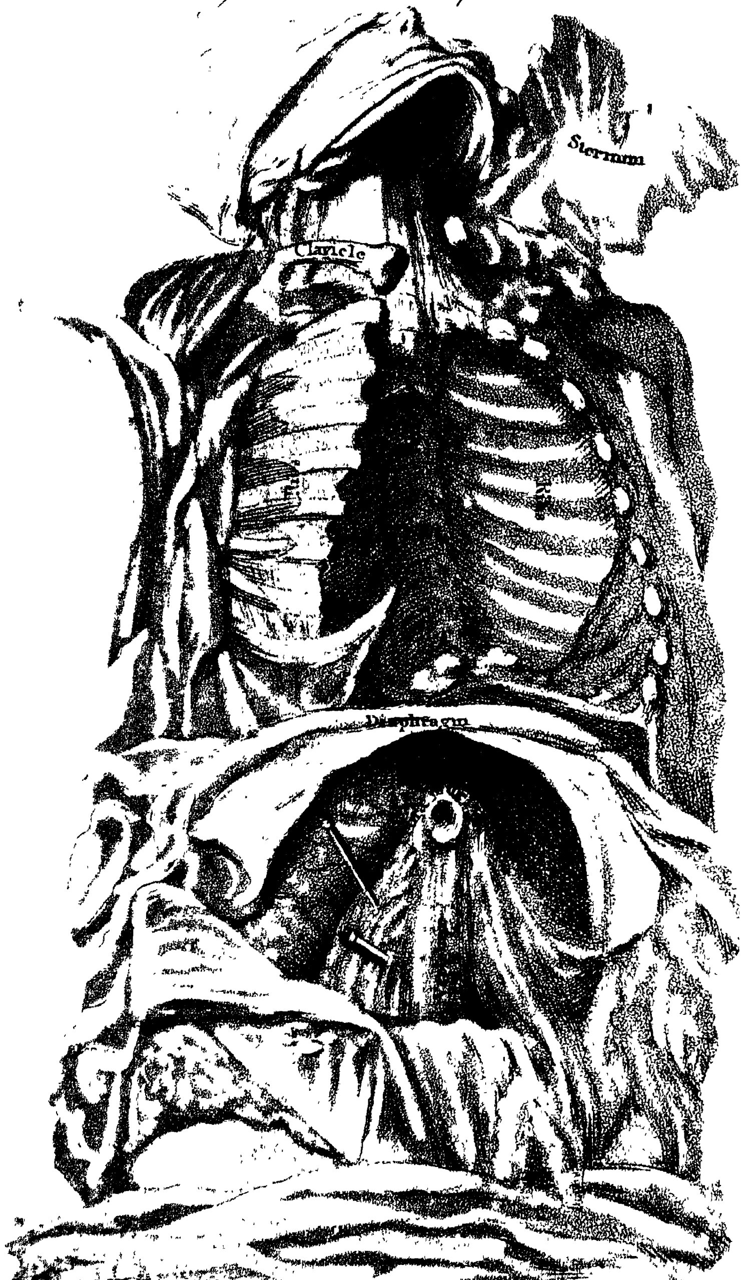
* The study of *anatomy*, as it leads to the knowledge of NATURE, needs not, says the illustrious Cheselden, many tedious descriptions, nor minute dissections; what is most worth knowing is soonest learned, and least subject to difficulties, while dividing and describing the parts, more than the knowledge of their uses requires, perplexes the learners, and makes the science tedious, dry, and difficult.

Upon this principle all the anatomical descriptions interspersed in this work will be conducted.

The *diaphragm*, or midriff, is a large broad muscle, that divides the *thorax* from the *abdomen*. In its natural state it is *concave* or vaulted above the *abdominal viscera*, and *convex* towards the *thoracic*. It is called, by Haller, "*Nobilissimus* "*post cor musculus*," and, like it, is in constant action. At

 the

The Body devested of the Viscera



observed to move a long while after the other, when the animal was dead, or at least, by irritating the *phrenic nerve* which goes to that muscle, it could be renewed. I have seen it, says Baron de Haller, irritable and tremble an hour or more after death, when the motion of the intestines had entirely ceased, and many others have witnessed the same along with me.

The Oesophagus, or gullet.

The ŒSOPHAGUS *, when irritated, contracts

the same time of inspiration, it is then a *plane*, and its motions are in general one fourth less than the heart. Besides being a muscle of inspiration; it assists in vomiting, and the expulsion of fordes; and it marks our passions by its irregular action, as sighing, yawning, coughing, laughing. It is affected by spasms, as in hiccup, lock-jaw, &c. It is both a muscle of voluntary and involuntary action, and the cause of its *involuntary action*, and its *general sympathy* with all the violent motions of the body, deserves a fuller attention of the philosophic anatomist than has been hitherto bestowed upon it. Some strong characters of special contrivance we cannot fail to observe here.

1st. The diaphragm separates posteriorly into *two slips*, betwixt which the *aorta descendens* passes.

2d. A little above this, and to the left side, in the most fleshy part of the diaphragm, there is a *direct opening* for the passage of the *aesophagus*, or gullet.

3d. There is also on the right side of the diaphragm a large triangular hole for the passage of the *vena cava ascendens*.

* The *aesophagus*, or gullet, is composed both of *longitudinal*, and *circular fibres*, but chiefly *circular*, abundantly more so than in the intestines; because this has no foreign power

tracts itſelf very ſenſibly, and I have plainly ſeen its periſtaltic motion after death, ſo that a morſel thruſt into the œſophagus will be puſhed upwards and downwards by the periſtaltic motion excited by that ſtimulus.

The Stomach. The STOMACH * is conſiderably *irritable*, and when touched with a corroſive, becomes immediately furrowed. If you irritate it with a knife, either at the *pylorus*, or elſewhere, it preſently contracts itſelf; and when wounded the *borders* of the wound *retract*. You may ſee the *motions* of the *ſtomach* through the tendinous part of the *diaphragm* after it has been laid bare, as alſo ſhining through the *peritonæum* while the ab-

power to aſſiſt it, and becauſe it is neceſſary the food ſhould make a ſhorter ſtay here than there. Hence it is that horſes drink againſt the law of gravity. The inner ſurface is a ſmooth membrane, abundantly ſupplied with *mucilage*, to ſheath this organ, and render the paſſage of the aliment eaſy.

* *The ſtomach* is ſituated on the *left ſide* below the ſhort ribs. The right ſide of the ſtomach is covered by the thin edge of the left lobe of the *liver*; the left preſſes on the *ſpleen*. Its figure nearly reſembles the pouch of a bagpipe, its *upper ſide* being concave, and the *lower* convex, and its *left end* moſt capacious. The entrance into the *œſophagus* on the left ſide is called the *cardia*; on the right, where the chyme paſſes into the *duodenum*, is named *pylorus*, where there is a *circular valve*, or *ſphincter muſcle*, which hinders a regurgitation of the aliment. The ſtomach has *circular* and *longitudinal fibres*, and its *inner membrane* is bedewed with a ſtrong and viſcid mucus.

domen

17. THE INTESTINAL TUBE, OR PRIMÆ VIÆ.

domen is entire. We therefore cannot doubt an inftant of this organ being *irritable*.

The INTESTINES *, both *large* and *fmall*, are extremely *irritable*. When the inteftine is only

The Inteftines.

* The *inteftinal canal* is ufually five times the length of the individual It is curiously convoluted in the abdomen This fpace anatomifts have thought fit to divide into 6 *portions*.

1ft. The *duodenum*, becaufe it is commonly reckoned in adults to be 12 inches long.—At a fmall diftance from where the ftomach joins it, the *common gall duct* and the *pancreatic duct* open into it, from the one it receives the *bile*, and from the other the *pancreatic juice*.

2d. The *jejunum*, from its being in general found *empty*, on account of the fluidity of the chyme, the ftimulus of this, and the bile, and the prodigious number of lacteals.

3d The *ileum*, becaufe of its fituation near the pelvis, where the bones projecting like the wings of a phaeton are called *Ilea*.

4th The *colon*, which takes an arched direction.

5th. The *cæcum*, or *blind gut*, a pouch, as it were, of the colon, about 3 inches long, and called *blind* from its being out of the direction of the paffage of the food. Its diameter is twice as large as that of the other inteftines. It has an *appendix*, called *vermiform*, whofe ufe is not well afcertained, which floats loofe in the abdomen, and in the mackerel there may be feen above 150 of them.

6th. The *rectum*, or *ftraight gut*, is the laft, and at its termination is furrounded by *circular mufcular fibres*, called the *fphincter ani*.

only slightly cut, the wound equally *retracts* its edges; but if cut quite through, these *curl* themselves *back*, so as to embrace the parts above, or, in other words, they turn inside out. When a part of the intestine only is irritated, it contracts so strongly there, that the cavity is quite closed, and the contents are pushed into the neighbouring parts, either upwards or downwards, which dilate, and soon afterwards, being irritated by their contents, they contract, and push along

The *three* first are termed the *small guts*, the *three* last the *great*. In the *small guts* there are numerous *plaits* to detain the food, and allow a wider surface for its absorption. These are larger, and far more numerous near the stomach, where the food is thinner, than they are towards the colon. At the entrance of the *ileum* into the *colon*, there are two *very large valves*, which prevent the regress of the fæces into the ileum. The *cæcum* and *colon*, besides having stronger muscular coats than the small intestines, are furnished with three *ligamentous bands*, running lengthwise on their outside, dividing their surface into three portions nearly equal. Though these appear like ligaments externally, they are made up in their inner structure of true muscular fibres. The ligament-like bands, which in the cæcum and colon are collected into *three* portions, are spread *equally over* the surface of the *rectum*; a wise precaution of nature, that no part of it may be weaker than another, lest it should give way in the efforts of egestion. The plaits are considerably fewer in the great guts. They have *all* an *inner membrane*, studded with an infinite number of arteries, or glands, which pour out a lubricating fluid. They have *muscular fibres* both *circular* and *longitudinal*.

 whatever

whatever is contained. Very often, after the motions of the inteſtines have ceaſed, they are renewed again, and increaſed by little and little, by ſome *obſcure cauſe* which reſtores the *irritability*. After they have been taken out of the body, I have obſerved, continues Baron de Haller, *this motion* rather to *increaſe*. They may be irritated *externally* either with a knife, a needle, alcohol, or corroſives, but their *internal ſurface* is much more irritable.

The GALL-DUCT *, and the *other excretory ducts*, are *inirritable*; that is, ſtimuli produce no motion in them. *The Ductus Communus Coledocbus.*

The ARTERIES have been always ſuppoſed to be *irritable*. This idea is countenanced, *firſt*, by ſeeing that the ſilk-worm has no heart, but only a large artery, which performs the office of a heart. *Secondly*, by the blood after death being expelled, whence theſe derive their name†; and *laſtly*, by the motion of the fluids continuing, as may be ſeen in a microſcope, even when the heart has been removed. Unleſs this was the caſe, the *pulſe* of the arteries, which reſembles the ſyſtole and diaſtole of the heart, will be very difficult to be accounted for. *The Arteries.*

* Or *common duct* of the *liver* and *gall-bladder*, which enters the *duodenum* oppoſite the *pancreatic duct*.

† *Arteries*, from *αηρ*, air; and *τηρεω*, to draw.

 The

The LACTEALS * contract and empty themſelves like the *arteries*, upon being touched with *vitriolic acid*, and there is the *ſame argument* for their being *irritable* as for the *arteries*, viz. though they be ever ſo full of chyle at the time when the animal dies, they empty themſelves, and contract in ſuch a manner, that you cannot diſcover any fluid within them in the *dead* animal.

When making a puncture with a knife, into the BLADDER † of a dog juſt dead, it will *contract* itſelf, and force out its contents through the opening made in the abdomen.

* Called ſo from their containing *chyle*, which has the appearance of milk. The *lacteals* are veſſels of abſorption of infinite ſmallneſs, ſituated in the inteſtines. They increaſe in ſize, and terminate in a gland, called, the *receptaculum chyli*, whence this fluid proceeds along the *thoracic duct*, which terminates in the left *ſubclavian vein*. The *valves* of the veſſels of abſorption are innumerable.

† For the anatomical deſcription of this organ, vide page 90.


Aorta
Heart

II. OF INIRRITABLE PARTS.

The LUNGS * appear devoid of *irritability*. The

* The *lungs* are situated on the right and left side of the heart. They are divided into two *lobes*, and these are subdivided into *lobules*, three on the right side and two on the left. The *trachea*, or wind-pipe, descends into the lungs, and forms innumerable *cells*, which have a communication with each other, and give to this viscus a [illegible] appearance. In the membranes of these cells are distributed the branches of the *two pulmonary* [illegible] returning vessels, or *pulmonary veins*. [illegible] "thought," says the great Cheselden, "that in these "cells, the AIR enters the blood-vessels and mixes with "the blood; but this opinion, however *probable*, wants "sufficient experiments to prove it; air being found in "the blood, as it certainly is, is no proof of its coming "this way, because it may enter with the chyle. I "think, says he, the most probable argument for the air "entering into the blood by the lungs, or rather *some par-* "*ticular parts* of the air, may be fetched from the known "experiment of each man in a diving bell wanting near a "gallon of fresh air in a minute; for if pressure only was "wanting, they often descend until the pressure of the "air is three or four times what it is on the surface of the "earth. Dr. Moore observes, that the water [illegible] has "very [illegible] consisting of larger vesicles than in "land [illegible] and conjectures that this probably is the "reason, why they bear to be longer without breathing, as "they are provided with a larger quantity of that JE NE "SCAI QUOI from the air, which is so necessary to life." We shall throughout this work trace, as far as possible, the

 true

Liver, Kidney, and Spleen.

The LIVER *, KIDNIES †, and SPLEEN ‡, have alſo *no irritability*; that is, they

true relation we ſtand in with reſpect to the external air, as upon the diſcovery of the true nature of the air, the great myſtery of the office of the lungs and chylification is unfolded, and other matters of the utmoſt importance in the theory and practice of phyſic.

* The *liver* is the largeſt gland in the body, of a duſky red colour, immediately ſituated under the vaulted cavity of the *diaphragm*, or midriff, chiefly on the *right ſide*, and ſomewhat on the *left* above the *ſtomach*. Exteriorly, or anteriorly, it is convex, inwardly it is concave; very thick in its ſuperior part, and thin in its inferior The upper ſide adheres to the diaphragm, and it is fixed to this, and the ſternum, or breaſt bone, by a broad ligament, called *ſuſpenſorium*. It is alſo tied to the navel by a ligamentous band, called *teres*, which is the umbilical vein of the fœtal ſtate degenerated into a ligament. Both theſe bands ſerve to ſuſpend it, while lying on the back, from ring too much on the ſubjacent *cava*, or otherwiſe it might preſs on this important returning veſſel, ſtop the circulation, and put a period to life. Dogs and cats, and other animals, who are deſigned for leaping, have their liver divided into many diſtinct lobules which prevent a too great concuſſion of this viſcus. Ours is divided into *two lobes*, of which the right is conſiderably the largeſt.

† The *kidnies* are two oval bodies, ſituated in the loins, contiguous to the two laſt ſhort ribs; the *right* under the *liver*, and the *left* under the *ſpleen*.

‡ The *ſpleen* is ſituated immediately under the *diaphragm*, above the left *kidney*, and between the *ſtomach* and *ribs*. In figure it reſembles a depreſſed oval, near twice as long as broad, and almoſt twice as broad as thick. It has been

Map of the Internal Abdominal Viscera, the External or Bowels being removed

they do not retract the edges of a wound made in them as do the muscles, or when irritated shew the least motion.

If you irritate a NERVE *, the muscle to which it is distributed is immediately *convulsed*; that is, it contracts its fibres, but in this experiment there will not be found the *smallest contraction of the nerve.* *The Nerves.*

I applied a mathematical instrument, says Baron de Haller, marked with very small divisions, lengthways, to a long nerve of a living dog, in such a manner as was certain to perceive the *slightest contraction*; but upon irritating the nerve *no contraction* whatever could be perceived.

been taken from dogs, says Cheselden, without any marked inconvenience to them. Its office is the late discovery of the celebrated lecturer on physiology, Dr. Haighton.

* *Nerves* are white, firm, solid cords, which arise from the *cerebrum*, *cerebellum*, and *spinal marrow*, and are spread over every sentient portion of the body by innumerable filaments. *Ten* pair of nerves issue from the brain itself, and *thirty* from the spinal marrow. Those that go to the organs of sense are considerably larger than the rest, and are in part divested of their outer covering or external tunic.

III. OF SENSIBLE PARTS.

To point out what parts were *ſenſible*, we have the following experiments.

The Cerebrum, Cerebellum, and Medulla Oblongata. Upon touching the BRAIN * with a knife, or in whatever way Baron de Haller did it, or upon applying any cauſtic body, the animal was ſeized with violent convulſions, and contorted his body on the one ſide or the other in the form of a bow, expreſſing by its ſcreams violent anguiſh.

The Spinal Marrow. Having thruſt a probe, ſays Dr. J. Johnſon, into the SPINAL MARROW †; all the muſcles of the limbs were violently convulſed.—The muſcles of the back were ſo convulſed that the animal was bent backwards as in opiſthotonos of the lock-jaw. The intercoſtal muſcles were all contracted, and their natural action, that of drawing all the ribs nearer each other and upwards, was rendered a matter of ocular demonſtration.

* The *brain* is divided into two portions; that ſituated in the upper part of the ſkull, is called *cerebrum*, and that in the hind part, under the former, *cerebellum*. On the external ſurface of the brain we ſee ſeveral inequalities, or *windings*, like the circumvolutions of the inteſtines, and the *cerebrum* divides into *two hemiſpheres*, while the *cerebellum* ſends out an *oblong projection*, which paſſes through the large hole of the occiput, called *medulla oblongata*.

† The *medulla ſpinalis*, or ſpinal marrow, is a continuation of the *medulla oblongata*.

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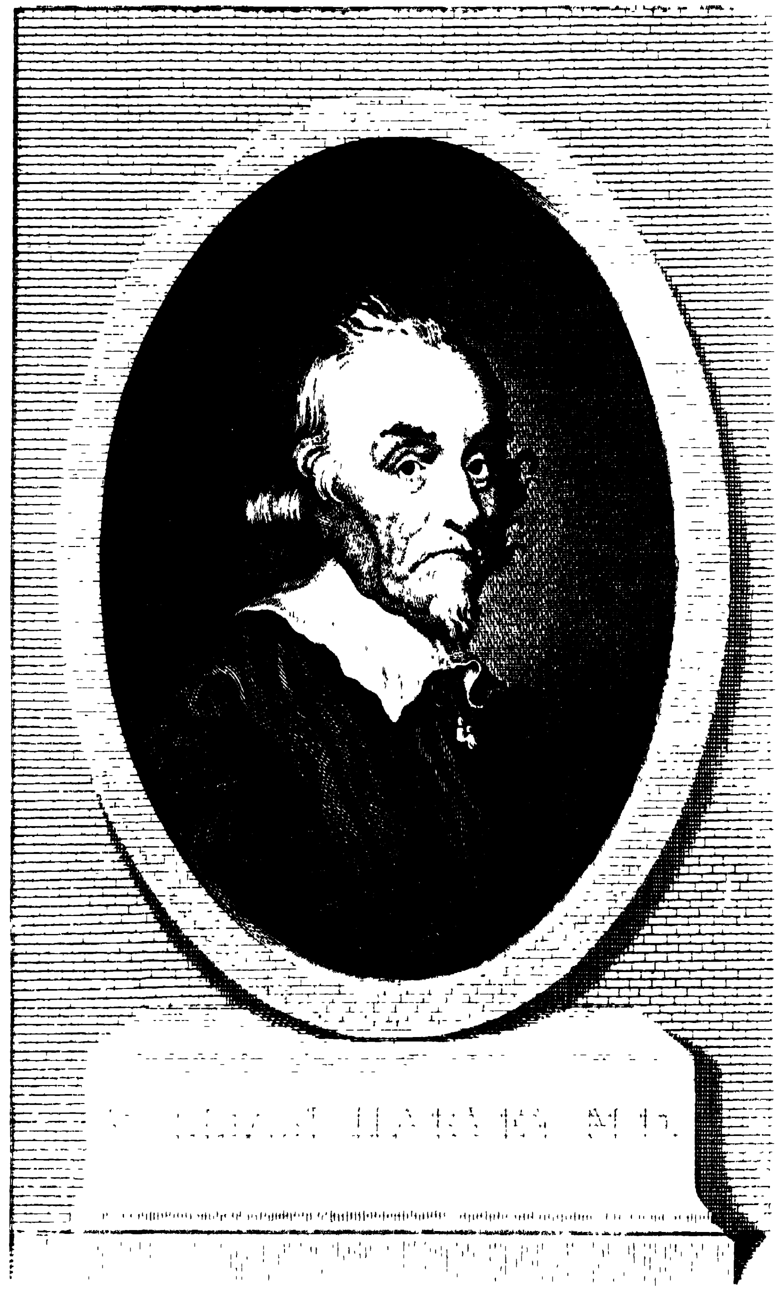


ſtration. The diaphragm was alſo ſtrongly contracted.

The NERVES *, which derive their ſource from the brain, are themſelves extremely ſenſible. It is impoſſible to repreſent to one's ſelf, without having ſeen it, the vaſt pain and diſquietude which an animal is thrown into upon touching, irritating, or even tying a nerve.

The SKIN †, as being abundantly ſupplied with

* The nerves have been before deſcribed.

† When a bliſter has been applied to the ſkin of a negro, if it has not been very ſtimulating, in twelve hours after a bladder is formed, which is the *cuticle* or *ſcarf ſkin*. When this fluid and ſkin is removed, the ſurface underneath appears black; but if the bliſter had been very ſtimulating, the membrane in which this colour reſides would have been raiſed with the cuticle. This is called the *rete mucoſum*, which is itſelf a double membrane, containing a peculiar mucus, which gives the colour to the ſkin.

Malpighi firſt diſcovered this double membrane in the tongue, and transferred it to the ſkin covering the body. The ſcarf-ſkin or cuticle, is colourleſs, and the difference in the complexion of people entirely depends upon the mucus of the *rete mucoſum*, being black in the negro, copper-colour in the mulatto, brown in the Egyptian, and white in the Albino, as in the inhabitants of cold climates. With us it becomes brown in thoſe expoſed to the beams of the ſun, and doubly ſo when reflected from the ſurface of the water, as in ſea voyages, or from the white ſands, as in Africa. The colour of this mucus is tranſmitted from parents to their children, but is capable of great modifications: the offspring of a black man by repeated intermar-

with nerves, is found to be extremely sensible, for in whatever manner you irritate it, the animal makes a noise, struggles, and gives all the indications of pain that it is capable of.

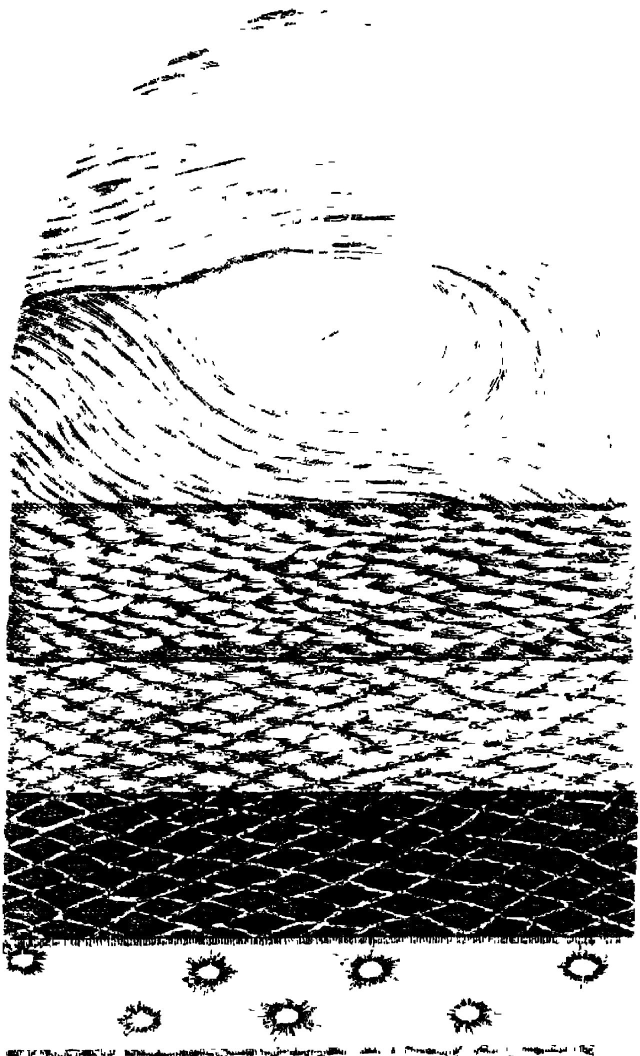
The INTERNAL MEMBRANES of the STOMACH*, INTESTINES, BLADDER†.

riages with white women, will in the fourth generatio become perfectly white; and the converse of this is equall true.

Immediately under the internal layer of the rete muco sum, Mr. Cruikshank discovered a *third lamen* by injec ing the skin of a person who had died of the small-po upon which are situated the pustules of this disease. Son have supposed that this was only a [illegible] of coagulab lymph betwixt the [illegible] mentioned membranes, and t true skin. We come now to what is called the *cutis ver* or *true skin*, which is always white in people of whatev complexion they be. It is exceedingly vascular, and e dowed with exquisite sensibility. It is extremely elast stretching as in dropsy, [illegible] after tapping, turning nearly to its natural dimensions. It is thickest those parts [illegible] by [illegible] weight or pressu and is [illegible] back, the so of the [illegible] It is thinner the [illegible] of the arms a legs, [illegible] surfaces. the lips [illegible] thin, so as to allow the colour of

* [illegible]

† The [illegible] part of the belly, immediately [illegible] of the pudendal bones, and above the [illegible] It is the reservoir of



and URETERS *, being of nearly the ſame nature with the ſkin †, does in conſequence enjoy the ſame ſenſibility.

The MUSCULAR FLESH is ſenſible of pain, which is dependant entirely on the nerves. For if you tie the nerve going to any part, that part becomes immediately *paralytic* below the ligature and *inſenſible.* Its vital functions however remain. A bliſter applied to the part below the inciſed nerve inflames and draws up the *The Muſcles.*

the urine or aqueous part of the blood ſecreted by the kidneys, and ſent from thence by its ducts, or *ureters*; its external paſſage is called *urethra*, the neck of which, or, more properly ſpeaking, the bladder, is ſecured by a *circular muſcle* called *ſphincter urinæ*, the fibres of which cloſe this opening, except under the great irritation of diſtention, or from the commands of the will. The coats, or tunics, of the bladder are the ſame as thoſe of the inteſtines, ſtomach, and œſophagus, viz. an *internal* membranous, ſenſible, and ſecreting mucus, a *middle* muſcular, and an *external* alſo membranous, but inſenſible.

* The *ureters* are tubes, about the ſize of gooſe quills, and about a foot long; they ariſe from the kidnies, and enter the bladder near its neck, running for the ſpace of an inch *obliquely* between its coats, they form to themſelves as it were valves, ſo that upon the contraction of the bladder, the urine is darted along the *urethra*, which is its proper paſſage.

† Theſe ſeveral parts *differ* anatomically from the ſkin in this. They have no *cuticle*, nor *rete mucoſum*, though they ſecrete a fluid analogous to this. They *differ* from the ſkin alſo in having *muſcular fibres* immediately under them.

outer

outer ſkin, though it does not create pain; ulcers are healed, and ſuppurate, and the limb ſeems to have loſt nothing but the power of motion.

The Breaſt. The Mammæ, or BREASTS *, as being covered with a good deal of ſkin, and furniſhed with many nerves, has alſo a proportionable degree of ſenſibility.

IV. OF INSENSIBLE PARTS.

In order to diſcover what parts were *inſenſible*, Baron de Haller made the following experiments.

The Dura Mater. The DURA MATER † is a kind of perioſteum, every where applied to the internal ſurface of the cranium, connected to it by veſſels, and has arteries tranſmitted through it to the ſkull, in the ſame manner as they are tranſmitted

* Each *breaſt* is a *conglomerate gland*, or an aſſemblage of glands to ſeparate milk, with their *excretory ducts*, which are capable of much diſtention, tending towards the nipple, and as they approach, unite, ſo as to make but a few ducts at their exit.

† The *dura mater* is a very compact ſtrong membrane lining the inſide of the ſkull, firmly adhering at its baſis, and but lightly at the upper part, except at the ſutures. It extends itſelf acroſs the ſkull, ſo as to divide the *cerebrum* into *two hemiſpheres*. This part of the membrane is called the *falx*, and prevents in great meaſure the concuſſion of this part. It again projects laterally, and ſuſtains the poſterior part of the *cerebrum*, which hinders it from compreſſing the *cerebellum*.

ted

ted through the periofteum to the other bones of the body. It is compofed, like all the other membranes of the body, of cellular fubftance, and like them is perfectly *infenfible*, fo that it may be burnt with vitriol, cut with a knife, or tore with a pair of pincers, without the animal, the object of the experiment, appearing to fuffer the leaft pain.

The brain naturally divides into two parts. The upper portion is called the *cerebrum*, and the fmaller and lower portion the *cerebellum*. Thefe are fheathed by a membranous covering called the PIA MATER *. Having removed, fays Baron de Haller, a portion of the fkull, with the *dura mater* contiguous to it, I touched it with butter of antimony, whereupon it was burnt to a fcar, without the animal complaining in the leaft, or making any fort of ftruggling, or being at all convulfed.

The Pia Mater.

The infenfibility of the PERIOSTEUM † was long ago obferved by Mr. Chefelden, nor are we at all furprifed at this, feeing there are no nerves diftributed to it. I have torn and burnt the *periofteum*, without the animal's fhewing the leaft fign of pain; nay young kids have fucked during the experiment: whereas when pinched they have fhewn the moft evident marks of pain.

The Periofteum.

* This is an exceeding fine *membrane*, which invefts the brain even between its folds, hemifpheres, &c.

† A fmooth *membrane* covering the bones.

That

The Peritonæum. That the PERITONÆUM * is *insensible* I proved by repeated experiments, which I carefully made, after I had dissected away the *recti muscles*, which cover this membrane.

The Pleura. I next made my experiment on the PLEURA †, having freed it from the *intercostal muscles*, which we know are well supplied with *nerves* (the

* Below the diaphragm, or midrif, under the muscles of the belly, lies that membranous expansion called the *peritonæum*, which is a much stronger covering than the pleura, and confines the intestines and contents of the abdomen.

† Every distinct part of the body is covered, and every cavity is lined, with a single *membrane*, whose thickness and strength is as the bulk of the part it belongs to, and as the friction to which it is naturally exposed. Those membranes, which contain distinct parts, keep the parts they contain together, and render their surfaces smooth, and less subject to be lacerated by the actions of the body: and those which line cavities, serve to render the cavities smooth and fit for the parts they contain to move against. The membranes of all the cavities that contain solid parts, are studded with glands, or are provided with vessels, which separate a *mucus* to make the parts contained move glibly against one another, and not adhere together. The *pleura* lines the whole cavity of the chest, where the heart and lungs are placed, and gives it that smooth and glossy appearance, which when these organs are removed we cannot fail to observe. It meets as it were on the breast-bone, on each side, and then becoming more compact, separates, and extending so as to form an acute triangle, it *divides* the two great lobes of the lungs, and is here called *mediastinum*. It then passes towards the vertebræ of the back, where it assumes again the name of pleura.

experiment was difficult, but I have frequently done it, and most succefsfully on a kid, it being a very quiet animal), and even upon the PERICARDIUM *, in all which cases the membranes being cut or irritated, occasioned no sense of pain, nor the least change in the animal. *The Pericardium.*

The celebrated Storch, as appears by the journal of the disease of which he died, was not sensible of any pain, while, in performing the paracentesis, the trocar pierced the *peritonæum*. Upon this occasion I foresee that many eminent physicians, who place the seat of head-ach and phrenites in the *membranes* of the brain, and the violent pain of the pleurisy in the membrane of the *pleura*, will differ from me in opinion. But I only relate facts, and as a searcher after truth, it is immaterial to me on which side nature decides the question. Neither are these truths altogether repugnant to pathology. Boerhaave affirmed long ago, that in inspiration, the *pleura* of the ribs was less upon the stretch, because the ribs by means of the intercostal muscles approached nearer each other, and on the contrary, in expiration, *this membrane* was more *tense* because the

* The *pericardium*, or heart purse, is an exceeding strong membrane, which covers the heart, even to its basis. Its uses are to keep the heart from having any friction with the lungs; and to contain a fluid to lubricate its surface. It is firmly fastened to the great vessels that enter into, and issue from, the heart; as also to the diaphragm.

ribs receded to a greater diſtance from each other. But in *pleuriſy* the patient ſuffers moſt in *inſpiration*; that is, when the *pleura* is *leaſt diſtended*, and *vice verſa*; wherefore that great man did not place the ſeat of this diſeaſe wholly in the *pleura*, but he joined it with an inflammation of the *intercoſtal muſcles*, which ſerve to bring the ribs nearer together, and which we have before proved to be a ſenſible part.

I am much diſpoſed, ſays the preſent celebrated profeſſor of phyſic at Ebinburgh, Dr. Monro, to join with thoſe who think that we miſtake the true ſeat of the pain in *pleuriſy*. I cauſed, ſays he, the operation for emphyſema to be performed three times, and I was particularly attentive to this queſtion. I ſcratched and tore the *pleura*, yet the patient did not make any remarkable complaint, and I would have concluded ſo, from this plain conſideration, what is the uſe of the pleura? It is a mere ſoft lining to obviate the evil of friction, and I could not imagine that *nature* would have formed this acutely ſenſible. I crooked a probe, and turning the point againſt the *pleura*, I pricked it rudely, and the patient juſt felt that I was preſſing him, but experienced no pain. In one caſe I cauſed the ſide to be perforated, and introduced a bougie *ten inches*, and turning it round, the patient felt ſomething moving, but no pain. I repeated this ſome days after the operation, when an inflammation was

come

come on, and ftill with the fame effect. I have repeated the experiments of Haller on quadrupeds, cutting away the intercoftal mufcles, and have torn away the *pleura* without the animal feeming to complain.

If the dura and pia mater, and likewife the periofteum, and the peritonæum, and pleura, be found void of fenfation, there is little expectation that other membranes fhould poffefs a different characteriftic property; and indeed the MEDIASTINUM and OMENTUM* are mere

The Mediaftinum and Omentum.

* The *omentum* or cawl, in Greek επίπλοον, is a broad, thin, and tranfparent membrane, arifing from the inferior and interior border of the ftomach, and reaching down as far as the navel; then doubling backwards and upwards, is connected with the colon. Befides its principal connections with the ftomach and colon, it is likewife attached to the duodenum, to the fpleen, pancreas, and *mefentery*, which is a membrane faftened to the inteftines, along which the lacteals run. The omentum lies immediately under the peritonæum. It is every where a double membrane; I fpeak not of its great fold already mentioned; but every portion of the thin membrane, by itfelf, may be divided into two thinner membranes which are joined together by cellular texture, in the cells of which the *fat* is depofited. The fecretion here is performed in the moft fimple manner, like fecretions in plants, there being no glandular apparatus. The fat is diftributed very unequally in the *omentum*, as you may find it in fome places very thin and tranfparent, and in other places above an inch thick. The omentum, or cawl, in calves, gives a very beautiful reprefentation of this fact. The *ufes* of the *omentum* are firft

mere reflections of *pleura*. All these membranes being destitute of nerves, are of the same nature as the CELLULAR MEMBRANE *, and are therefore insensible to stimuli.

The Cellular Membrane.

There

to interpose between the peritonæum, the intestines, and the stomach, to keep all these parts moist, warm, slippery, and to hinder their adhesion; but most probably its chief use is to furnish *oil* to the liver to be converted into *bile*, which is chiefly composed of *alkali* (azot and hydrogen) and *oil* (hydrogen and oxygen). For the fat, though it is deposited in the cells of the omentum, yet must it have some kind of circulation; otherwise its store would be continually augmenting beyond measure; and as there are here no other excretory ducts but veins, and these all terminate in the *vena portarum*, which vessel goes to the liver, carrying to its secretory vessels that fluid, from whence in part *bile* is generated; and hence it is a reservoir for the formation of the bile, as the spleen is for the formation of the pancreatic juice

* The *cellular texture* is continued without interruption all over the body, and is insinuated into every recess. It is composed, not of fibres laid together or interwoven, nor of small tubes, or vessels, though they run along it, being only adventitious, and no part of its true structure, but of unorganized *lamellæ*, like fine scales. The lamellæ receding from one another, which partly again uniting transversely, form cells, in such a manner as to communicate together all over from head to foot. If we conceive a sponge, in which every cell opens into all those that are contiguous to it, we shall form a just idea of the cellular texture. Its *cells* are in some places smaller, in others larger; it is dilatable by a very small force, where it is not confined by the resistance of neighbouring parts. Where its cells are largest, and its texture loosest, it contains fat, as immediately under

There is no doubt of the CUTICLE, or ſcarfſkin, being inſenſible, ſeeing you may cut it, as with corns, which is only an increaſed cuticle, or burn it with nitrous acid, until you give it a durable taint, without occaſioning the leaſt pain. *The Cuticle.*

THIS GLUTEN, which divides the cuticle from the cutis vera, or true ſkin, as it cannot *The Rete Mucoſum.*

der the ſkin, almoſt over all the ſurface of the body, between it and the moſt external muſcles; in the intervals, or interſtices, between one muſcle and another; in the omentum, around the kidneys, &c. This membrane, web, or texture, by laborious diſſection, by blowing air into it, by injections, by maceration, hath been found to follow every viſible bundle of muſcular fibres, every tendon, every veſſel, even every the minuteſt nerve. We ſhall find it conſtituting a great part of the œſophagus, ſtomach, inteſtines, urinary bladder, &c. So that there is no phyſical point in the whole animal fabric, in which there is not a portion of the cellular texture. Its *uſe* and importance in the animal body is very great. It ſerves as a bond of union by tying and faſtening all the parts together, yet in ſuch a manner, as not to prevent or obſtruct their neceſſary motions. to contain fat, if required; or marrow; or ſerum; or a thin vapour; to render parts ſmooth, and moiſt, and flexible; and to hinder them from growing together. It yields a commodious way or road for veſſels and nerves to glide along. It furniſhes a conſiderable part of the linings of the great cavities of the body, and immediately covers and envelops each particular viſcus of the body; inſomuch that *Haller*, who, of all anatomiſts, hath moſt minutely examined, and moſt fully and extenſively conſidered it, declares, "that for certain the far greateſt part of the animal "body is compoſed of it."

eaſily be ſeparated from the cuticle, it become impoſſible to try experiments upon it; bu one may reaſonably ſuppoſe, like *other fluids*, it has no feeling.

The Fat The FAT is a fluid contained within the cellular membrane. That this fluid may be pierced without inflicting pain, may be ſeen by a needle thruſt into the fleſh of a hog, who will ſhew no ſigns of pain, until it has got quite through the fat and reached the fleſh below.

The Tendons. The conſtant event of my experiments was, that the animal whoſe TENDON * was lacerated, burnt, or pricked, remained quiet, without ſhewing any ſigns of pain, and when part of the wounded tendon remained, it would walk without complaining. After I was fully ſatisfied of the event, I had no difficulty in diſcovering the cauſe, there being *no nerves* that I could trace to that part. Seeing therefore in the human body the nerves *only* are capable of ſenſation, it is neither unnatural nor improbable that the tendons being deſtitute of nerves ſhould have no ſenſation. I have oftener than once ſeen the tendons laid bare in men, and emboldened by the experiments which I have made on brutes, I once laid hold, with a pair of forceps, of the naked tendon of the flexor, that bends the third

* *Tendons* are not condenſed muſcular fibres, but condenſed cellular membranes attached to muſcular fibres, for the convenience and beauty of this elegant part of our machinery

joint

ioii . of the fore-finger, without the gentleman being in the leaſt ſenſible of it. I have likewiſe ſeen the ſupinator longus chafed with hot oil of turpentine, in order to ſtop an hæmorrhage; it occaſioned an acute pain in the ſkin, but the patient felt none in the tendon. Wherefore there is no need of fear from the accident of the ruptured tendon. I have ſeen a new cellular ſubſtance grow in a few days, and unite the *tendo achillis* that was cut through in a dog. As ſoon as the edges were united, the animal ſuffered no inconvenience, and jumped with the ſame agility upon the chairs as before.

When we cut open, ſays a very eminent phyſiologiſt*, a faſcia or *tendinous membrane*, there is little pain: when, as in amputation, we cut the tendons even and neat, there is no pain: when we ſnip with our ſciſſars the ragged *tendons* of a bruiſed finger to cut it off, the patient does not feel: and laſtly, when we ſee *tendons* of ſuppurated fingers lying flat in their ſheaths, we draw them out with our forceps, or touch them with probes, without exciting pain. Oil of vitriol has been poured upon each of the parts belonging to a joint, and a piece of cauſtic has been dropped into its cavity, but ſtill no pain enſued; nay, ſome have been ſo bold, may I not ſay ſo vicious, as to repeat theſe experiments upon the human body,

* Mr. John Bell of Edinburgh.

pinching, pricking, and burning the *tendons* of the leg, and piercing them with knives, in a poor man, whofe condition did not exempt him from this hard treatment; who was ignorant of this injuftice that was done him, while his cure was protracted, and he was made a cruel fpectacle for a whole city!

The Capsule and Ligaments. In a cat I filled, fays Baron de Haller, the articulation of the femur with the pelvis with vitriolic acid, without its feeming to feel this violent corrofive. Sometimes inftead of cauftics I have tried the knife, and have tranfpierced the CAPSULE of the knee, and the LIGAMENTS, and fcraped the patella, without the animal fhewing the leaft fign of pain. And indeed it is well ordered by nature, that thofe parts which are expofed to continued friction fhould be void of fenfation *.

The Bones. The infenfibility of BONES is ftill difputed, and indeed I have made no experiments upon this fubject, for in that cruel torture which is required to lay bare the bones it is nearly impoffible to diftinguifh the two pains. In the large bones I never could find any nerve entering the

* In a ftate of health thefe parts are certainly *infenfible*. In the ftate of difeafe are the neighbouring and fenfient parts *alfo* in a ftate of difeafe, or whence the pain from *white fwellings*, &c.? This fubject deferves the moft ferious attention of the philofophic anatomift, and we fhall again reconfider it when treating on difeafes.

bone,

bone, and I have ſeen the operation of the trepan performed upon ſound perſons who had the free uſe of their ſenſes, without their complaining of any increaſed pain during the perforation of the cranium *.

The Marrow. Several authors have affirmed the MARROW to be extremely ſenſible, but ſeeing no nerves enter the bones, and that it is of the ſame nature as fat, it appears highly improbable.

The Teeth The ſenſibility of the TEETH † to heat and cold is wiſely provided, that nothing might paſs into the ſtomach that might irritate ſo important an organ. But otherwiſe they are inſenſible, being often ſcaled and filed without the perſon complaining in the leaſt.

The Gums. It is wiſely ordained that the GUMS ‡ ſhould be inſenſible. Hence they ſerve, when the teeth are removed, the office of maſtication, and are lanced or cut without the leaſt ſenſation of pain.

* In the caſe of *nodes*, &c. are not the bones ſenſible?

† The *teeth* are of three kinds.

1. The *inciſores*, or cutting-teeth, being made of the form of a chiſſel.
2. The *canini*, or dog-teeth, being pointed in the form of an awl.
3. The *molares*, or grinders, having a flat and uneven ſurface for the grinding of food, ſhaped like an anvil.

‡ In the ſtate of *inflammation* they ſeem to have ſome ſenſe of feeling, and excite a dull ſenſation of pain.

We have seen then there is a difference in the parts of the human body, according to the several *uses* for which they are designed; some are vascular and soft, others bony and hard: some sensible, and very prone to inflammation and disease; others callous and insensible, have little action in their natural state, and little proneness to disease.

The greater part of the body is merely insensible and inirritable matter, united into a moving and perfect whole. In some places there is such a conflux of nerves, as form the most delicate and perfect sense, endowing that part with the fullest life; while others are left without nerves, almost inanimate and dead, lest feeling, where it ought not to be, should derange the whole system.

The living parts of the system are the muscles and nerves; the *muscles* to move the body, and perform its offices, each muscle * answering to its particular stimuli, and most of them obeying the commands of the will; the *nerves* to feel, to suffer, and to enjoy, to issue the commands of the will, bringing the muscles into action: but still the muscles have their own *peculiar life*, or *irritability*, superior to the nerves, and independent of them. It is a power which survives that of the

* Including the *hollow muscles*, as the heart, arteries, lymphatics, stomach, intestines, &c.

nerves,

nerves, acting even when severed from the general system; and acting often on the living body, without the impulse of the nerves, and sometimes in opposition to the will.

The insensible and inirritable matter of the system joins these living parts, and performs for them every subservient office,—forms coverings for the brain;—coats for the nerves;—sheaths for the muscles;—tendons,—ligaments,—and all the apparatus for the joints; unites them into one whole by a continued tissue of cellular substance, which has no interruption, and suffers no change, but still preserves its own insensible nature, while it joins the sentient and moving parts to each other. The tendons, ligaments, periosteum, and capsules of joints, are all composed of this cellular substance, which by its *elasticity*, binds and connects the parts, and by its dead and insensible nature, is less exposed to disease, and appears therefore to be the fittest medium of connexion for the *living* system. To conclude,

Baron de Haller, therefore, properly calls that a SENSIBLE PART of the human body, which, upon being hurt, transmits the impression to the soul: or which, in other words, occasions evident signs of pain and disquiet in the animal. On the contrary, he calls that INSENSIBLE, which being burnt, tore, pricked, or cut till it is quite destroyed, occasions no sign of pain or convulsion, nor any sort of change in the situation of the

the body: and he calls that an IRRITABLE PART, which becomes ſhorter upon being touched; very irritable if it contracts upon a ſlight touch, and the contrary, if by a violent touch it contracts but little.

We have therefore a *threefold diviſion* of the human body into PARTS,

1. SENSIBLE;
2. INSENSIBLE; and
3. IRRITABLE *.

As long as medical ſcience was built, not upon the ſubſtantial baſis of actual experiment, but imagined properties, aſſumed as data, it was changing every day its forms; for one fanciful opinion has always a right to ſupplant another. At length the ſun of ſcience aroſe, which diſpelled thoſe miſts which obſcured ſo ſublime a ſcience, who following the maxim of Bacon, wiſely exclaimed, "Non fingendum aut excogi-

* It is with ſome reluctance that I preſent to the humane Reader this uſeful detail of experiments on animals, though I think a better apology may be given for theſe, than for the *diverſions* of hunting, fiſhing, and ſhooting, which are univerſally tolerated in civilized ſocieties:—and, perhaps, the compaſſionate Reader, like thoſe who do not object to the enjoyment of the fruits of theſe ſports and paſtimes, as they are improperly called, ſo may be peruſe with ſome pleaſure the concluſions drawn from the ſufferings of nature, inflicted by man on animals, from the more *exalted motive* of *philanthropy*.

"tandum,

"tandum, ſed inveniendum quid natura faciat aut "ferat:" that the operations of nature were not to be fancied, but diligently ſcrutinized. Hence in the ſhorteſt ſpace of time, the principle of philoſophiſing being altered, more light was thrown upon every branch of ſcience than it had received for above two thouſand years before. He who laid the real foundation for the true ſcience of medicine, was, as we have ſeen, the celebrated Haller. He was the ſon of an advocate of conſiderable eminence in his profeſſion. His father had a numerous family, and Albert was the youngeſt of five ſons. From the firſt period of his education, he ſhewed a very great genius for literature of every kind: to forward the progreſs of his ſtudies, his father took into his family a private tutor, named Abraham Billodz; and ſuch was the diſcipline exerted by this pedagogue, that the accidental ſight of him, at any future period of life, excited in Haller very great uneaſineſs, and renewed all his former terrors. According to the accounts which are given us, the progreſs of Haller's ſtudies, at the earlieſt periods of life, was rapid almoſt beyond belief. When other children were beginning only to read, he was ſtudying Bayle and Moreri; and at nine years of age he was able to tranſlate Greek, and was beginning the ſtudy of Hebrew. Not long after this, however, the courſe of his education was ſomewhat interrupt-

Life of Haller.

ed by the death of his father; an event which happened when he was in the 13th year of his age. After this he was fent to the public fchool at Bern, where he exhibited many fpecimens of early and uncommon genius. He was diftinguifhed for his knowledge in the Greek and Latin languages; but he was chiefly remarkable for his poetical genius: and his effays of this kind, which were publifhed in the German language, were read and admired throughout the whole empire. In the 16th year of his age he began the ftudy of medicine at Tubingen, under thofe eminent teachers Duvernoy and Camerarius; and continued there for the fpace of two years, when the great reputation of the juftly celebrated Boerhaave drew him to Leyden. Nor was this diftinguifhed teacher the only man from whofe fuperior abilities he had there an opportunity of profiting. Ruyfch was ftill alive, and Albinus was rifing into fame. Animated by fuch examples, he fpent all the day, and the greateft part of the night, in the moft intenfe ftudy; and the proficiency which he made, gained him univerfal efteem both from his teachers and fellow ftudents. From Holland, in the year 1727, he came to England. Here, however, his ftay was but fhort; and it was rather his intention to vifit the illuftrious men of that period, than to profecute his ftudies at London. He formed connexions with fome of the moft eminent of them. He

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was honoured with the friendſhip of Douglas and Cheſelden; and he met with a reception proportioned to his merit from Sir Hans Sloane, preſident of the Royal Society. After his viſit to Britain, he went to France; and there, under thoſe eminent maſters, Winſlow and Le Dran, with the latter of whom he reſided during his ſtay in Paris, he had opportunities of proſecuting anatomy, which he had not before enjoyed. But the zeal of our young anatomiſt was greater than the prejudices of the people at that period, even in the enlightened city of Paris, could admit of. An information being lodged againſt him to the police for diſſecting dead bodies, he was obliged to cut ſhort his anatomical inveſtigations by a precipitate retreat. Still, however, intent on the farther proſecution of this ſtudy, he went to Baſil, where he became a pupil to the celebrated Bernoulli.

Thus improved and inſtructed by the lectures of the moſt diſtinguiſhed teachers of that period, added to uncommon natural abilities, and unremitting induſtry, he returned to the place of his nativity in the 26th year of his age. Not long after, he offered himſelf a candidate, firſt for the office of phyſician to an hoſpital, and afterwards for a profeſſorſhip. But neither the character which he had before he left his native country, nor the fame which he had acquired and ſupported while abroad, were ſufficient to combat

combat the intereſt oppoſed to him. He was diſappointed in both; and it was even with difficulty that he obtained, in the following year, the appointment of keeper of a public library at Bern. The exerciſe of this office was indeed by no means ſuited to his great abilities: but it was agreeable to him, as it afforded him an opportunity for that extenſive reading by which he has been ſo juſtly diſtinguiſhed. The neglect of his merit, which marked his firſt outſet, neither diminiſhed his ardour for medical purſuits, nor detracted from his reputation either at home or abroad: for ſoon after he was called to quit his country. George II. king of Great Britain, being deſirous of promoting the proſperity of the univerſity of Gottingen, invited M. de Haller, and eſtabliſhed for him there an anatomical, botanical, and ſurgical profeſſorſhip. The duties of this important office he diſcharged, with no leſs honour to himſelf than advantage to the public, during the ſpace of 17 years; and it afforded him an ample field for the exertion of thoſe great talents which he poſſeſſed.

The taſk of teaching a ſcience, in all its parts, to a claſs of ſcholars at an univerſity, ſhould ſeem ſufficient to employ the whole time which a ſociety has a right to expect the moſt laborious man to ſacrifice. The objects of medicine include the deareſt intereſts of man, his health and exiſtence. In this ſcience, uncertainty is never

never indifferent, and error always dangerous, in its consequences. The art is founded on an intimate knowledge of the organization of the human body, a ſtructure, the harmony and proportions of which, though moſt wiſely and accurately formed, are liable to be deranged by innumerable accidents. The means of reſtoring health are exceedingly multiplied, and the ſelection of remedies as delicate as important. To this ſcience a variety of other knowledge is requiſite; and each ſpecies opens an extenſive field for inquiry. Every day produces new diſcoveries, which it is neceſſary a profeſſor ſhould not only be acquainted with, but examine and explain. Beſides public lectures, private inſtructions are to be given to his pupils. The ſlothful are to be ſtimulated, the diligent encouraged; thoſe who are ſlow of underſtanding to be more particularly and patiently informed; and thoſe of brilliant and quick parts, reſtrained from deviating from the ſimple paths of nature, and wandering too far into the labyrinths of ſpeculative hypotheſis. To effect theſe purpoſes requires much time, labour, and application.

Notwithſtanding theſe important employments, the ſeventeen years which M. Haller ſpent at Gottingen, were thoſe, in which he executed his great works; and during this period, his ſuperior literary reputation was acquired. The detail of all his reſearches, nay, the mere liſt of his writings,

ings, would exceed our present bounds; and it will be necessary to pass over several, which would have been highly ornamental and honourable to any other author, and to confine ourselves to those great works which must certainly immortalise the name of Haller.

He availed himself of his credit with the king of Great Britain to procure the most useful institutions for the university over which he presided. Amongst these was a school for surgery; an academy of sciences; a hospital for lying-in-women, in which the art of midwifery is taught; a collection of anatomical preparations; and a school for design, where the pupils were instructed to delineate with precision and truth all the objects of natural history. This last institution is hitherto the only one of its kind, whereas, academies of painting are very numerous.

He selected *physiology* as the principal object of his studies; a branch of medicine which, penetrating into the intimate structure of the various parts of the body, inquires into the laws by which man is formed, developed, grows, lives, decays, and dies; in what manner each organ performs its proper motions, and regulates the offices to which it is destined; by what means the organs, whose necessary functions continually tend to their own destruction, are capable of being repaired by nourishment and sleep; by

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what mechanism, a power, the principle of which is unknown to us, sometimes executes, at the command of the will, actions that are necessary to the preservation and prosperity of man, and at other times produces, independently of the will, operations which are essential to his existence. *Physiology* also investigates the mode in which the changes in these organs, at one time, are the cause, and at another, the effect, of disorders in the vital functions; what connexion exists between the alterations in these functions, and the diseases of the parts which execute them; and, lastly, in what manner remedies of every kind, by their action on these organs, possess the power of re-establishing order in the animal œconomy.

M. de Haller was not uninformed, that this Science, having been long devoted to the spirit of system, had become suspicious to *philosophical* physicians; but these objections were what he proposed to obviate. He entertained the hope of rendering *physiology* as certain as any other physical science: a science by which philosophers might learn the knowledge of nature, and where physicians might find a basis on which they might support their practice.

To this end, it was necessary to endeavour to establish *physiology* on an exact anatomy of man and of other animals; by the latter of which so many discoveries have been made concerning

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the animal œconomy of our own ſpecies, which had not been revealed by the ſtudy of the human body. It was neceſſary to baniſh, from *phyſiology*, both that metaphyſical jargon, which has long ſerved, in all the ſciences, to cover real ignorance under ſcientific words, and thoſe theories, whether mathematical or chemical, which have been doubted even by mathematicians and chemiſts themſelves; and are conſtantly made uſe of with ſo much more confidence, or adopted with greater reſpect, in proportion as the maſters or ſcholars are more completely ignorant of the foundations on which they have been erected. It was neceſſary to ſubſtitute to all theſe ſyſtems, general *facts*, eſtabliſhed by obſervation and experiment; to poſſeſs ſagacity to lay hold of theſe facts; to try to aſcertain their cauſes, and yet to acknowledge that, in all the ſciences, there are bounds beyond which it is doubtful whether the human mind will ever be able to penetrate, but which it aſſuredly cannot paſs, but by the aſſiſtance of time and a long courſe of labour, and often through accident.

Such was the plan which our profeſſor had formed; and he purſued it with that activity and ſucceſs, which he has exhibited in his other works, as an accurate and profound *natural philoſopher*. He was ſo truly original in phyſiology, that, even in his life-time, his cotemporaries and

rivals placed him in the firſt rank of writers on thoſe ſubjects.

But it was not till after he had examined, in a numerous ſuite of memoirs, the important and difficult queſtions concerning reſpiration, the circulation of the blood, muſcular motion, and the formation of the bones, that he thought himſelf qualified to comprehend *phyſiology* in its full extent: and even then his firſt edition bore the modeſt title of a mere *eſſay*. Nor was it till after thirty years of labour and immenſe reſearches, that he thought himſelf juſtified in beſtowing on his work the title of, *Elementa Phyſiologia*. Extenſively acquainted with the ſentiments of others reſpecting the economy of the human body, ſtruck with the diverſity of opinions which they held, and ſenſible that the only means of inveſtigating truth was by careful and candid experiment, he undertook the arduous taſk of exploring the phænomena of human nature from the original ſource. In theſe purſuits he was no leſs induſtrious than ſucceſsful, and there was hardly any function of the body on which his experiments did not reflect either a new or a ſtronger light. In this work all the parts of the human body are deſcribed; we have there an opportunity of examining the opinions which have been recommended, or at leaſt advanced by celebrated authors, who have attributed different uſes to the ſame parts. M. de

 Haller

Haller did not always decide between these opinions; sometimes he proved that they ought all to be rejected. Nothing of importance that had been previously published, escaped his observation, and he almost uniformly added remarks of his own to the intelligence he had obtained from books or conversation.

We shall not here enter into the immense detail of errors which Haller has destroyed in *physiology*; of new facts which he has added; of the ingenious and deep views which he has opened; of the doubts he has cleared up, or of the theories he has perfected or reformed: this would be to copy nearly the whole of his work. We shall confine ourselves chiefly to those subjects which relate chiefly to the object of this work, viz. *irritability*. It was not long necessary for him, in this arduous inquiry, to labour alone The example of the preceptor inspired his pupils with the spirit of industrious exertion. Zinn, Zimmerman, Caldani, and many others, animated by a generous emulation, laboured with indefatigable industry to prosecute and to perfect the discoveries of their great master. And the mutual exertion of the teacher and his students, not only tended to forward the progress of medical science, but placed the philosophy of the human body on a more sure, and an almost entirely *new basis*. But the labours of Dr. Haller, during his residence at Gottingen, were by no means con-

fined to any one department of ſcience. He was not more anxious to be an improver himſelf, than to inſtigate others to ſimilar purſuits. Such diſtinguiſhed merit could not fail to meet with a ſuitable reward from the ſovereign under whoſe protection he then taught. The king of Great Britain not only honoured him with every mark of attention which he himſelf could beſtow, but procured him alſo letters of nobility from the emperor. On the death of Dillenius, he had an offer of the profeſſorſhip of Botany at Oxford; the ſtates of Holland invited him to the chair of the younger Albinus; the king of Pruſſia was anxious that he ſhould be the ſucceſſor of Maupertuis at Berlin. Marſhal Keith wrote to him in the name of his ſovereign, offering him the chancellorſhip of the univerſity of Halle, vacant by the death of the celebrated Wolff. Count Orlow invited him to Ruſſia, in the name of his miſtreſs the empreſs, offering him a diſtinguiſhed place at St. Peterſburgh. The king of Sweden conferred on him an unſolicited honour, by raiſing him to the rank of knighthood of the order of the polar ſtar; and the emperor of Germany did him the honour of a perſonal viſit; during which he thought it no degradation of his character to paſs ſome time with him in the moſt familiar converſation.

Thus honoured by ſovereigns, revered by men

of literature, and efteemed by all Europe, he had it in his power to have held the higheft rank in fociety. Yet, declining all the tempting offers which were made to him, he continued at Gottingen, anxioufly endeavouring to extend the rifing fame of that medical fchool. But after 17 years refidence in that univerfity, an ill ftate of health rendering him lefs fit for the duties of the important office which he held, he folicited and obtained permiffion from the regency of Hanover to return to his native city of Bern. His fellow-citizens, who might at firft have fixed him among themfelves, with no lefs honour than advantage to their city, were now as fenfible as others of his fuperior merit. A penfion was fettled upon him for life, aud he was nominated at different times to fill the moft important offices in the ftate. Thefe occupations, however, did not diminifh his ardour for ufeful improvements. He was the firft prefident, as well as the greateft promoter, of the Œconomical Society at Bern; and he may be confidered as the father and founder of the Orphan Hofpital of that city. Declining health, however, reftrained his exertions in the more active fcenes of life, and for many years he was confined entirely to his own houfe. Even this, however, could not put a period to his utility: for, with indefatigable induftry, he continued his favourite employment

of

of writing till within a few days of his death; which happened in the 70th year of his age, on the 12th of December 1777.

The next perſon of eminence who ſtands forward as an improver of the ſcience of medicine is the celebrated Dr. CULLEN. As a teacher he had peculiar merit. He always mingled the moſt agreeable eloquence with deep diſquiſition. From the moment he aſcended the chair, he commanded the moſt reſpectful attention from his pupils, inſomuch that no ſtudent was ever obſerved to quit the threatre during the time he was lecturing. He was univerſally allowed to be an accurate anatomiſt, and a moſt ingenious phyſiologiſt. He enlarged the boundaries of chemiſtry, and has the honour of being the inſtructor of the illuſtrious Dr. Black. He was intimately acquainted with all the branches of natural philoſophy, and had ſtudied well every ſyſtem of ancient and modern phyſic. He found that of Boerhaave univerſally adopted, when he accepted the chair in the univerſity of Edinburgh. Dr. Cullen ably expoſed the errors of this pathology, and paid conſiderable attention to the *nervous ſyſtem*, as beſt explanatory of the nature of ſeveral diſeaſes.

Life of Dr. Cullen.

The brain, ſays he, ſeems by its conſtitution, to be diſpoſed to the alternate ſtates of *reſt* and *activity*; as appears in the alternate ſtates of ſleep and waking, which conſtantly take place in

His ſyſtem.

every animal; but wherein this conſtitution conſiſts, it is difficult to diſcover.

The moſt common opinion is, that the *brain* is a ſecretory organ, which ſecretes *a fluid* neceſſary to the functions of the nervous ſyſtem; that this fluid is *alternately exhauſted* and *recruited*, and thereby gives occaſion to the *alternate ſtates* of *ſleep* and *waking*. But this ſuppoſition is attended with many difficulties. The *nervous fluid* in the brain is truly capable of *different ſtates* or *degrees of mobility*, which we ſhall call its ſtates of EXCITEMENT and COLLAPSE; but without intending, by theſe terms, to expreſs or determine any thing with regard to the nature of the *nervous fluid*, or wherein its different ſtates conſiſt.

This ſubject may be further illuſtrated, by obſerving, that the *excitement* of the brain appear to be in very different degrees on different occaſions. It ſeems to be *greateſt* in certain maniacs endued with uncommon ſtrength, reſiſting the force of moſt impreſſions, and with the utmoſt difficulty admitting ſleep.

A leſſer degree of *excitement* occurs in the ordinary ſtate of waking in health, when the excitement is total with reſpect to the functions of the brain, but readily admitting of ſleep.

This excitement may be conſidered as of two kinds; either as it reſpects the vigour, or as it reſpects

refpects the mobility of the fyftem: and thefe different ftates of the brain are expreffed in the body, by ftrength or debility, alacrity or fluggifhnefs; and in the mind, by courage or timidity, gaiety or fadnefs.

A degree of collapfe takes place in the cafe of natural fleep, when the collapfe prevails fo far as to fufpend very entirely the exercife of the animal functions; and, though the exercife of the vital and natural continue, they are confiderably weakened.

A *partial collapfe* may take place in the brain, which difcovers itfelf by the delirium which appears in a ftate that often occurs as intermediate between fleep and waking; and even in fleep the collapfe with refpect to the animal functions, takes place more or lefs entirely; whence the fleep is with or without dreaming, and the dreaming is more or lefs active.

A ftill *greater degree of collapfe* takes place in the cafe of fyncope; in which it is fo great, as to fufpend the exercife of the vital functions concerned in the circulation of the blood, notwithftanding the force of habit in thefe, and their being expofed to conftant ftimuli. Here the collapfe may be very confiderable; but there ftill remains fome degree of excitement while the brain can be acted upon by ftimuli, *which act only on vital powers*, and while its ufual excitement is ftill recoverable by fuch ftimuli.

If

If the *collapse* is *still more complete* and irrecoverable, it is the state of DEATH.

From what is now said of the *excitement* and *collapse* of the brain, it will appear, that we suppose LIFE, so far as it is corporeal, to consist in the *excitement* of the *nervous system*, and especially of the brain, which unites the different parts, and forms them into a whole. But, as certain other functions of the body are necessary to the support of this excitement, we thence learn, that the causes of death may be of two kinds; one that acts *directly* on the nervous system, destroying its excitement; and another that *indirectly* produces the same effect, by destroying the organs and functions necessary to its support. Of the first kind are chiefly the causes of sleep operating in a higher degree; as cold, sedative passions, poisons, and all causes of very violent excitement.

This doctrine of EXCITEMENT and COLLAPSE, with *other expressions*, have caused some to believe that Dr. Cullen gave the first hint to Dr. Brown for the establishment of his celebrated system, yet upon comparing the theory and practice of the two, we shall find a wide difference; and as the one attributed every thing to the brain and nerves, so the other attributed all the phænomena of life to the fibrous system, extending his doctrine to plants, which are

living bodies, but without a nervous ſyſtem. Dr. Cullen's ſyſtem has, however, great merit.

If Dr. Cullen did not lay the foundation of the true ſyſtem of phyſic, he had, however, a principal ſhare in the merit of delivering medicine from the fetters of the Latin, and introducing the Engliſh language, as the vehicle of public inſtruction in the univerſity of Edinburgh. Much of the revolution ſince experienced in medicine, I believe, may be aſcribed to this circumſtance. The many improvements which have lately been made in medicine, muſt chiefly be aſcribed to the preſent faſhionable cuſtom of communicating medical knowledge in the Engliſh language. By this means our ſcience has excited the notice and inquiries of ingenious and obſerving men in all profeſſions, and thereby a kind of galaxy has been created in the hemiſphere of medicine. By aſſuming an Engliſh dreſs, it has moreover been prepared more eaſily to aſſociate with other ſciences; from each of which it has received aſſiſtance and ſupport.

In his intercourſe with his pupils Dr. Cullen was truly kind and affectionate. Never have I known a man who poſſeſſed in a higher degree thoſe qualities which ſeize upon every affection of the heart. He knew the rare and happy art, as circumſtances required, of being affable without being ſociable; ſociable without being familiar;

miliar; and familiar, without losing a particle of respect. Such was the interest he took in the health, studies, and future establishment of all his pupils, that each of them believed that he possessed a pre-eminence in his friendship; while the equal diffusion of his kind offices proved that he was the common friend and father of them all. Sometimes he would lay aside the distance, without lessening the dignity of the professor, and mix with his pupils at his table upon terms of the most endearing equality. Upon these occasions his social affections seemed to have an influence upon his mind. Science, sentiment, and convivial humour, appeared for hours together to strive which should predominate in his conversation. I appeal to those gentlemen, who have shared in the pleasure which I have described, for the justice of the picture which I have drawn of him at his hospitable table. They will recollect, with me, how agreeably he accommodated himself to our different capacities and tempers; how kindly he dissipated our youthful blushes, by inviting us to ask him questions; and how much he taught us, by his inquiries, of the nature of diseases of our own districts.

From the history that has been given of Dr. Cullen, we shall not be surprised at the reputation which he gave to the university of Edinburgh, for upwards of thirty years. The city of Edinburgh during his life became the emporium

of

of medicine. But let me not here be unjuſt to the merits of his illuſtrious colleagues. The names of Whytt, Rutherford, the Monroes, Black, the Gregories, Hope, and Home, will always be dear to the lovers of medical ſcience. May every healing plant bloom upon the graves of thoſe of them who are departed! and may thoſe who have ſurvived him, together with their new aſſociate, the learned and laborious Dr. Duncan, long continue to maintain the honour of that juſtly celebrated ſchool of medicine!

It remains now that I add a ſhort remark on Dr. Cullen's conduct as a phyſician and a man.

In his attendance upon his patients, he made their health his firſt object. So gentle and ſympathizing was Dr. Cullen's manner in a ſick room, that pain and diſtreſs ſeemed to be ſuſpended in his preſence. Hope followed his footſteps, and death appeared frequently to drop his commiſſion in a combat with his ſkill. He was compaſſionate and charitable to the poor; and from his pupils, who conſulted him in ſickneſs, he conſtantly refuſed to receive any pecuniary ſatisfaction for his ſervices.

In his intercourſe with the world he exhibited the manners of a well bred gentleman. He exercifed upon all occaſions the agreeable art, in which true politeneſs is ſaid to conſiſt, of ſpeaking with civility, and liſtening with attention to every body. His converſation was at all times

animated, agreeable, and inſtructing. Few perſons went into his company without learning ſomething; and even a common thought, by paſſing through his mind, received an impreſſion, which made it ever afterwards worthy of being preſerved.

He was a ſtrict œconomiſt of time. He ſeldom went out of his houſe in his carriage, without a book in his hand; and he once told me, that he frequently employed one of his ſons to read to him after he went to bed, that he might not loſe that portion of time which paſſes between lying down, and falling aſleep.

He was remarkably punctual to all his profeſſional engagements. He appeared to conſider time as a ſpecies of property, which no man had a right to take from another without his conſent.

It was by means of his œconomy and punctuality in the uſe of time, that he accompliſhed ſo much in his profeſſion. I have read, ſays Dr. Ruſh, of ſome men who have ſpent more time in their cloſets, and of others who have done more buſineſs; but I have never ſeen, nor heard of a man, who mingled more ſtudy and buſineſs together. He lived by rule, without ſubjecting himſelf to the ſlavery of forms. He was always employed, but never in a hurry; and amidſt the numerous and complicated avocations of ſtudy and buſineſs, he appeared to enjoy the pleaſure of ſociety, as if keeping

ing company and converſation were the only buſineſs of his life.

It pleaſed God to prolong the life of Dr. Cullen to a good old age. He lived near 78 years. He lived to demonſtrate how much the ſtrength of the faculties of the mind depends upon their conſtant exerciſe. He lived to teach his brethren by his example, that the obligations to acquire and communicate knowledge, ſhould ceaſe only with health and life; and laſtly, he lived to reap the fruits of his labours in the moſt extenſive fame; for not only his pupils, and his works, had conveyed his reputation; but canvaſs, paper, and clay, had borne even the image of his perſon to every quarter of the globe.

He reſigned his profeſſorſhip in the autumn of 1789, on account of bodily weakneſs, and died in the month of January of the year 1790; a year fatal to the pride of man; for this year Franklin and Howard, as well as Cullen, have mingled with the duſt. During the interval between his reſignation and his death he received the moſt affectionate marks of public and private reſpect. The city of Edinburgh voted him their thanks, and preſented him with a piece of plate. This inſtance of public gratitude deſerves our particular attention, as it is more common for cities to treat their eminent literary characters with neglect during their lives, and centuries afterwards to contend for the honour of having

ing given them birth. And the different medical ſocieties of Edinburgh followed him to his chamber with addreſſes full of gratitude and affection.

But while we celebrate the praiſes of Dr. Cullen, let us take care leſt we check a ſpirit of free inquiry, by too great a regard for his authority in medicine. I well remember an obſervation ſuited to our purpoſe, which he delivered in his introduction to a courſe of lectures on the Inſtitutes of Medicines in the year 1766. After ſpeaking of the long continued and extenſive empire of Galen in the ſchools of phyſic, he ſaid, " It is a great diſadvantage to any ſcience " to have been improved by a great man. His " authority impoſes indolence, timidity, or idol- " atry upon all who come after him."—Let us then avoid theſe evils in our veneration for Dr. Cullen.

Life of Dr. Brown.

We come now to the hiſtory of him who may with truth be reckoned the father of the true ſcience of medicine. Before Dr. BROWN's time all was involved in miſts and errors, Others might have ſhone forth like a meteor through the gloom, but in the writings of Dr. John Brown we ſee generally the effulgence of the noon-day. He was educated in phyſic by Dr. Cullen. Dr. Brown's knowledge of the Latin language * ſerved

* It is recorded that Brown, even when a boy, diſplayed a genius for literature, far ſuperior to any ſcholar in the grammar-

ed him as an introduction; and his circumſtances might have induced Dr. Cullen to believe that he could* render this talent permanently uſeful to himſelf, or he had been ſtruck with the ſuperior

grammar-ſchool of Dunſe, according to Mr. Cruikſhank, who was an able maſter; and Mr. Wait teſtifies he was a prodigy, being ſoon able to read with the utmoſt facility both the Latin and Greek languages; and ſo aſtoniſhing was the power of his memory, that he could recite a page or two of any book after once or twice reading it. John Brown continued at the grammar ſchool at Dunſe until twenty years of age, when he was appointed private tutor to a family of ſome diſtinction in the neighbourhood, after which he returned back in capacity of uſher to the ſame ſchool, where he ſtaid a year. He was ambitious of ſettling at Edinburgh. He was aware that ſtudents of phyſic are in general by no means qualified to hold a diſcourſe in Latin. Hence, before the examination for a doctor's degree, which is carried on in Latin, it is common to have recourſe to a private inſtructor, who contrives anſwers to the queſtions that may be probably put. This preparation is called *grinding*, and *cramming*. The tranſlation of inaugural diſſertations into Latin, which the ſtudents, in moſt inſtances, compoſe for themſelves in Engliſh, is another occupation, that a good ſcholar might derive emolument by at Edinburgh, the gratuity for a tranſlation being from five to ten guineas. Of his qualification for theſe employments accident ſhortly furniſhed him with an agreeable proof. An application of this ſort was made to him, and what he did was highly approved of. He accordingly ſet out for Edinburgh, and upon his arrival he addreſſed a Latin letter to each of the Medical Profeſſors. In conſequence of which they each preſented him with a ticket of admiſſion to their lectures. Hence the origin of his firſt acquaintance with Dr. Cullen.

abilities of this young man. Taking him therefore under his immediate patronage, he gave him employment as a private inſtructor in his own family, and ſpared no pains in cultivating his friendſhip: this favoured pupil was finally permitted to give evening lectures, in which he inculcated the doctrines of Dr. Cullen, and as Dr. Beddoes relates, read from Dr. Cullen's own notes. But, alas! friendſhip originating in protection, is very prone to terminate in enmity, unleſs where difference of rank and purſuits totally preclude competition. Theſe two great, but oppoſite geniuſes, however, lived for ſeveral years in the ſtricteſt friendſhip. Dr. Brown's eldeſt ſon was not chriſtened only William, but had alſo the ſurname of Cullen, attached to his name, being named by his godfather, *William Cullen Brown*. It is obſerved, that ſuch was their intimacy, that Dr. Brown could take, whenever he pleaſed, a bottle of wine from Dr. Cullen's cellar; and during all this time no man in Dr. Brown's company could *contradict* any of *Cullen's opinions* without receiving an acrimonious anſwer. A medical chair happening to become vacant by the death of Dr. Gregory, Dr. John Brown gave in his name as a candidate. The magiſtrates of Edinburgh had the appointment of this office. They inquired of Dr. Cullen whom this unknown candidate was, who is reported to have exclaimed in the dialect of his country, " Why, ſure, this can never be

" our

" our Jock!" The haughty temper of Dr. Brown had never once ſolicited the intereſt of his friend, and had even idly conceived, that pre-eminent qualifications were ſufficient to ſecure ſucceſs His application was in conſequence ſet aſide. Brown with great difficulty ſtomached the affront, and when he afterwards offered himſelf as a candidate for the philoſophical ſociety, which publiſhed the Edinburgh Eſſays, and was rejected, he aſcribed the whole to Dr. Cullen, and broke out into an avowed enmity. He publicly complained, " that his open conduct to him " was friendly, when his ruin was premeditated, " the plot ſecret, a dark Catalinian conſpiracy. " Accordingly his ſuſpicions were late, the full " detection later." He gave to the public the following particular account of this tranſaction. " I reſolved within myſelf," ſays Dr. Brown, " to " tear off the maſk of pretended friendſhip. My " firſt ſtep was to make application for being " made a member of a certain literary ſociety, " to which no man's petition had ever been re-" jected before, or ſince, foreſeeing that I ſhould " be rejected. This accordingly happened. I " had been previouſly adviſed by one of their " body not to preſent my letter of application. " This friendly monitor (alluding to Dr. Cullen), " knowing that I had *meditated* a *new doctrine* " *of phyſic*, began to be apprehenſive leſt it " ſhould ſupplant *his own*, and he was the ſe-

 " cret

" cret but prime mover of the plot. My an-
" swer was in a tone of firmneſs, that the ap-
" plication ſhould not be withdrawn."—After the failure of this bold attempt upon his credit, Brown became completely eſtranged from Dr. Cullen, and very ſhortly after publiſhed his Elementa Medicinæ (Elements of Phyſic), which have ſince made ſuch a noiſe in the world. The approbation this work gained, induced him to give lectures, and his cuſtom was to tranſlate the paſſages of his work by piecemeal to his pupils, commenting upon each paragraph. In order to increaſe his fervour while lecturing, he had always by him a bottle of whiſky and laudanum, and before he commenced, he would frequently take a glaſs of the one, and ten or fifteen drops of the other, and even repeat the doſe four or five times during the lecture. Between the effects of theſe ſtimulants and voluntary exertion, he ſoon waxed warm, and by degrees his imagination was nearly exalted into phrenzy*; nevertheleſs

* In the Elements of Phyſic, Vol. I. p. 120, we have the following curious note.—"Homer obſerves of the hero, whom he gives for a pattern of eloquence, that upon his firſt addreſs, that is while he was under ſome agitation, and had not yet gotten into his train of thought, he was awkward in every motion, and in his whole attitude, he looked down to the ground, his hands hung ſtraight along his ſides as if powerleſs. his whole appearance was torpid. But when he once entered upon his ſubject, his eyes were all fire, his


JOHN BROWN M.D.

vertheless it is obferved, that when he became animated, he had fine cadences and pleafing tones. As a fpecimen of the fervour of his genius, fpeaking of the doctrine of fpafm, he fays, " that it
" was firft fuggefted by Van Helmont, and clum-
" fily wrought up into a fyftem by Hoffman,
" and after being banifhed by Boerhaave, it
" found a protector and a friend in CULLEN.
" This brat, this feeble, half-vital, femi-produc-
" tion of folly, the ftarveling of ftrained fyfte-
" matic dulnefs, the forlorn outcaft of the fof-
" tering care to which it owed its infect vita-
" lity, was now pampered by a crude and in-
" digeftible nutriture, was decorated with every
" foreign plumage, and in this its totally bor-
" rowed and heterogeneous form, inftead of the

his limbs all motion, with force, grace, and energy. *Upon commencing a lecture, the pupils have often obferved the fame torpor in the lecturer, and a fimilar vivacity and life in a few minutes, when he had gotten fairly into his fubject: the report which a lecturer's daughter, upon looking through the hole of a door, while the lecture was going on, made to the family and fome company then prefent, was, that her father looked, in his lecture, as if he would look through his hearers.* Mr. Donaldfon is one of the few great mafters, in the art of painting, who never fail, with a moft exact likenefs, to difplay the whole influence of the mind upon the features. A miniature of the author, done by him, as a prefent, is reckoned the greateft mafter-piece in thefe refpects, that ever came from the hands of a painter." An engraving from this very miniature we are happy to be enabled to prefent to our readers.

 " hideous

" hideous caricatura, which it was, formed to " excite the derision of mankind, it was ostentatiously obtruded upon the world as a new, " and respectable doctrine, and held up, forsooth, " as the formidable rival of my system."—Speaking of the professors of medicine he describes them " as having a sly attention to reputation " for skill; intriguing with their brethren for " countenance; opposition to improvement; persecution of discovery; narrowness of mind " under the thin veil of false pretension to liberality; affectation of decency, all for the " purposes of trade; silence, from a consciousness of inability to speak on general topics with advantage; formality, pomp; stateliness; gravity; invincible attachment to the " errors of education; ready upon every slight " occasion to break out into rage and transport; " an invincible bigotry and prejudice; an overvalue of what slender learning they may have " some pretensions to; and an under-value of " what they are conscious they do not possess." Such was his illiberal language, and hurry of ideas, when he had occasion to think of the system, and allowed reputation of his ancient protector and teacher. He was soon in a state of avowed hostility with the other medical professors in Edinburgh. Mr. Wainman, a student in medicine who attended his lectures was desirous of quoting in his Thesis on Epilepsy,

lepſy, paragraphs lxix, lxx, and lxxi, from the Elementa, and requeſted this permiſſion of Profeſſor Monro, ſubmitting to him the following conſiderations.

1ſt. That without it he was prevented from ſaying what *he really believed to be true*, to the manifeſt injury of his diſſertation. And,

2dly. Would be deprived of the liberty other candidates had always enjoyed of quoting from *any author*.

He had an anſwer as follows.

Sir,

I object to your quotation, not as containing the opinion of *this doctor*, or *that profeſſor*, but as containing ſuch *a jargon* as could not fail to *diſgrace* the *candidates*, and of courſe the *univerſity*. As to the *liberty* you ſay candidates have *always enjoyed* of making quotations from *any author* right or *wrong*, I never heard of it before, and *am determined to give* it *no quarter* neither *now* nor *hereafter*.

Alexander Monro.

This letter could not fail to come into Dr. Brown's poſſeſſion, who publicly complained of barefaced injuſtice towards thoſe ſtudents who attended his lectures, and of unuſual ſeverity towards them upon examination when graduating. So indignant was Dr. Brown, that he proceed-

ed in triumph with thirteen of his pupils to Aberdeen, where they took their degree. He deſcribed with pleaſure his triumphant entry, and the awe that the profeſſors there ſtood in of him and his pupils: but, as Dr. Beddoes obſerves, their diſpatch more probably aroſe from their eagerneſs to partake of the ſpoils ariſing from a diſunited univerſity. This expedient could not add much to his claſs, where pupils are moſtly under the guidance of parents. His lectures were very thinly attended. But it was obſerved, that it was the cleverest ſtudents who were among his pupils. His doctrines began to be canvaſſed in the Royal Medical Society, and ſo warm were the debates they excited, that a law was obliged to be made, that no duels ſhould take place from perſonalities committed when diſcuſſing the ſyſtem of Dr. John Brown, under the pain of expulſion.

The reader is probably by this time impatient to have ſome account of this celebrated ſyſtem. The author of it ſays, in the preface to the Elementa, that he ſpent above twenty years in learning, teaching, and diligently ſcrutinizing * every

* Dr. Beddoes relates, that he learnt from the beſt authority, that Dr. Brown being anxious to acquire a more minute anatomical knowledge than he had gained by attendance on the public lectures, for ſome time attended private inſtructions at five o'clock every morning, continuing with his inſtructor two hours, and botanical information was added on theſe occaſions to the anatomical.

part

part of medicine. The first five years passed away in hearing others, in studying what he had heard, implicitly believing it, and entering upon the possession, as a valuable inheritance. His employment, the next five years, was to explain more clearly the several particulars, to enlarge, refine, and polish *. The same number of years had the same occupation; but doubts now often occurred, and faith was staggered. "All this "time passed away," adds Dr. Brown, "with-"out the acquisition of any thing valuable in the "healing art; without that which, of all things, "is the most agreeable to the mind, *the light of* "*truth*, so great and precious a portion of the "short and perishable life of man, to me was "totally lost! I was at this period in the situ-"ation of a traveller in an unknown country, "who, after losing every trace of his way, wan-"ders in the shades of night; nor was it till be-"tween the fifteenth and twentieth year of my "studies that a faint gleam of light, like the "first break of day, dawned in upon me."

Contemplating the condition of man, Dr. Brown observed, that he was surrounded by *external agents*, which acted upon him while *alive*, and their effects ceased when dead. These he called *stimuli*, and the *living principle* brought into action by these, *excitability*; and the word *excite-*

* He probably alludes here to the evening lectures he delivered on Dr. Cullen's doctrines. Vide page 130.

ment

ment was uſed to expreſs the *action* produced by ſtimuli. Every thing in nature, that had any action on the frame, he conceived to be *ſtimulant*; and upon this principle *life* appeared to him a *forced ſtate* dependent on [illegible] and [illegible] diſeaſe might be referred to the action of *theſe powers*, and *the condition* [illegible] *ability*, which *varied conſiderably*, [illegible] becoming *perfectly ſtationary*.

By a ſteady obſervance of theſe principles he diſcovered an affinity between plague and idiopathic dropſy, as well as between catarrh and the diſtinct ſmall-pox; between the confluent ſmall-pox and gout, as well as between peripneumony and mania. And riſing gradually from ſuch partial to more general reſemblances, he came at laſt to diſcern, "that whenever either ex- "ceſſive vigour or debility prevailed in any con- "courſe of ſymptoms, they conſtituted a caſe of "diſeaſe preciſely [illegible] all other caſes where "ſuch increaſe [illegible] on of the healthy "vigour occur[illegible] led "by the ſame "faithful thread of diſpaſſionate attention to na- "ture, through the labyrinth of medical igno- "rance, empty diſtinction, and falſe aſſertion of "facts," he, in fine, attained his univerſal propoſition, "that there are only two idiopathic "diſeaſes: and that even theſe are not produced "by powers different in kind, but only in de- "gree." And from thence he drew his broad

concluſion,

conclusion, "That all the states of whatever "can be called life in the universe, were ow- "ing to this difference of degree. To this re- "specting disease, nothing can be added, but "that some diseases arising [illegible] the solids, as "simple and intimate, or a [illegible] of organiza- "tion, may [illegible] sometimes affect "the general system; whether it does or not, "it must be [illegible] slightly different from "idiopathic affection in its causes and mode of "cure; these being local, while those of disease "are general." But how complete have the aberrations of physicians been from this rule? how unobservant of its wide and vast illumination?

Dr. Brown in the 35th year of his age, was for the [illegible] with a fit of the *gout*. He was told by a great leader in the profession *, that [illegible] commonly vigorous and healthy constitution [illegible] with con- "comitant [illegible] pre- "vailing over [illegible] doubted cause "of the disease [illegible] other vegetable "matter employed as an [illegible], with a strict absti- "nence from every form of animal food, pro- "mised almost a certainty that he would never "have another fit." He took this, therefore, as a fact; the result of much experience and accurate observation. He had hitherto almost never ex-

* Dr. Cullen.

perienced

perienced pain, and the pain of the gout was rather too exquiſite for the firſt trial of his patience. Betwixt his diffidence in the theories, and ſome reliance on the facts of medicine, he reſolved to riſk the experiment. For the courſe of a year, he made water his only drink, and pure vegetable matter his only food. The event of this regimen was, *four fits* of the gout, each of them of *ſix weeks continuance*, before he had any uſe of his affected limb: and indeed, through the whole year, it was but a very ſhort time that he had the free uſe of it. After this experiment, his diſtruſt of medical facts commenced. He thus reaſoned with himſelf: "If plethora and vi-
"gour were the cauſes of this diſeaſe, occaſioned
"by repletion proving an overbalance for eva-
"cuation, why did it not happen ten years
"ſooner? eſpecially as he could recollect, that,
"both at that time, and before it, and after it,
"his indulgence in food and drink had been
"greater, and his exerciſe leſs, than they had
"been for a conſiderable time before this attack
"of the gout."

He now began to ſee that he muſt give up the logic, the philoſophy, and the facts, of phyſic as it then prevailed; that he muſt forget all his reading and all his knowledge; and, if he did not burn, as Paracelſus did, all the moſt famous books that came in his way, he muſt ſhut them all, and ſeal each of them with ſeven ſeals, till

he

he ſaw what he might make of his own thoughts. The firſt thing that ſtruck him, examining for himſelf, was, " that the human machine was " nothing in itſelf, but in conſtant and mo- " mentary dependance upon a number of powers, " perfectly diſtinct from it, the operation of " which was neceſſary to its exiſtence." His intercourſe with the means of life, and his obſervation upon theſe, taught him, " that men who " are well nouriſhed by food and drink were " ſtrong, and thoſe who had a ſcanty allowance " of either, but eſpecially of both, were weak." He had obſerved, " that farmers in Scotland in " good circumſtances were much ſtronger than " their labourers; and that farmers in Eng- " land in proportional circumſtances were as " much ſtronger than them." He had been told, " that 12 ſeapoys in Eaſt India could not " do the work of one Engliſh ſervant." He had been informed, " that in ſome counties of " England, the farmers would not engage their " ſervants unleſs they undertook to be very dex- " terous in ſwallowing the moſt nutrient ani- " mal food." He had diſcovered * " the field- " work in Scotland was tardily carried on by " the labourers, eſpecially the reapers, whoſe la- " bour is the ſevereſt of all; being ſupported " by nothing but porridge at the riſing and ſet- " ting of the ſun, and coarſe barley or oat bread

* Theſe are Dr. Brown's expreſſions.

" diſtributed

"distributed to them, not in excessive propor-"tion, at dinner, along with a plentiful pro-"portion of broth, consisting of nothing but "water and purgative fermenting vegetables." He had further perceived, "that meat and "drink only were not sufficient to support ani-"mal life." He found "other circumstances, "which he has enumerated in the 6th, 7th, and "8th, par. of his Elements, without any one of "which he could see that life could not be sup-"ported for the shortest space of time." He next reflected, "that a quantity of medical trash "stood in the way of his conclusion." After getting upon the fair road, in which nature's operations respecting animal, and therefore every mode of life, were to be prosecuted, he consi-sidered these with great composure as so many "Jacks a-lanthorns, that had misled him from the "right path into all the bogs and quagmires, over "all the precipices of delusion and error." He re-gretted "the time that he had lost in the tractless "wilderness of false speculation: but he consoled "himself with the satisfaction of finding the truth "at last. The sun of light arose in his hemisphere, "and displayed all the objects around him in their "true colours, and figures, and states. By the "influence of this newly discovered light, he be-"held the phantoms of innate powers of the living "system; whether denominated *vires medicatrices* "*naturæ*, or increased action of the animated sys-"tem

"tem, or reaction, or intermittent types, or
"irritation supposed to arise from spasm, or ple-
"thora, or mobility; as so many false meteors
"which had led him a tedious, painful, fruitless,
"and malicious dance. The same true light
"disclosed to his eyes other phantoms, which had
"formerly appeared to him more like natural
"figures, but that now stood forth in all the
"deformity and horror of infernal dæmons.
"These were symptoms as producing diagno-
"stics; symptoms as forming the new depart-
"ment of nosology; symptoms as estimated with-
"out regard to what they came from, or what
"might become of them. The sun-beams of truth
"exhibited all these appearances as a number of
"monstrous chimeras, to which there was no re-
"semblance in the simple and just productions of
"nature, but the illusory abortions of the visionary
"and disordered heads, to whom the slightest
"glance of the beauty, uniformity, comeliness,
"proportion and symmetry of nature, had been
"denied, and from whose eyes the book of life
"had been decreed to be shut for ever. He now
"perceived, that all the pillars, upon which the
"fabric of physic had stood for ages, must be
"tore up from their foundations, the rubbish
"cleared away, and the doctrinal as well as prac-
"tical part of the profession placed upon a better
"foundation."

To return to the subject of gout. After the former reasoning with himself against the commonly

commonly ſuppoſed cauſe and the method of cure of that diſeaſe, he obſerved, "that the ſti-"mulant powers neceſſary to the ſupport of life, "could be applied in ſuch a degree as to im-"pair or even deſtroy life, in a ſhort ſpace of "time. This is the noted effect of exceſs in "drinking: and the deaths that ſtand on record, "as produced by intemperance in eating, are "ſo many proofs of the ſame effect, ariſing from "exceſs in that mode of ſtimulus *. Exceſs of "paſſion, exceſs of exercise of the intellectual "operation, exceſs in corporeal motion, all tend "to the ſame event. Diſeaſes and ſudden deaths "have originated from every one of theſe modes "of exceſs in the uſe of the ſtimuli neceſſary to "the ſupport of life." He extended this obſer-vation, and found, "that the ſame effect that "could be prouduced by a high exceſs of the "ſtimuli in a ſhort ſpace of time, would as cer-"tainly ariſe from a more moderate exceſs in a "longer ſpace of time." In this manner he diſ-

* The Brunonian ſyſtem has been often accuſed of promoting intemperance. the objection is ſerious, but the allegation is falſe No writer has ever inſiſted ſo much as Dr. Brown on the inevitable conſequences of exceſs. "Since," ſays he, "Providence has granted us a remedy "by no means diſagreeable or inelegant, and one that is "certain, yet let us not abuſe his mercy, by bringing on "through our own inattention this diſeaſe, by theſe ſti-"mulants, for their frequent uſe muſt be attended with "danger, and our temerity will be at length chaſtiſed." Vide Elements, the ſection on the Gout

covered,

covered, "that death is as unavoidable a result "of the stimuli necessary to the production of life, "as life itself*." This excessive use of the cause of life, he observed to cause a state of debility which he called *indirect*; and, because there is a state of debility depending upon deficiency of stimulus, he called this "*indirect debility*." All this applied to the disease in question. He considered himself, some years before his first fit of the gout, as stronger and more full of blood than when it happened. Though he seemed stronger than many others, and perhaps was so, he did not judge of himself by that rule. It was a comparison of that kind that misled physicians to assert, that the gout was a disease of strong and robust persons. It is so: but they should have observed, that these strong and robust persons were less so than they had been formerly; in short, *compared* with their former state of vigour, that they were in a state of debility.

Finding, then, that *debility*, not plethora and vigour, was the cause of this disease, the indication of cure arose of course. It was, not to weaken the system by antiphlogistic regimen, according to the prevailing practice, but to invigorate it; only keeping within that excess of the means for the purpose, which terminates

* See his Elem. Med. xix, xx. [illegible]

in *indirect debility* *. Proceeding upon this cautious induction of facts, he saw before-hand, that the plan of cure he was to enter upon must be successful. And the event justified his expectation. In the course of *two years*, excepting two weeks, he had only *one fit*; which, in violence and duration, did not equal a fourth part of any of his former ones. And he was certain that he had even accelerated it by a piece of improper management, which was, intense walking, and the use of tight shoes, and taking a purge of Glauber's salts to remove an inflammatory sore throat. Now, if, what every physician of any observation at all will most readily grant, be taken into the consideration, that fits of the gout become always more frequent as the disease advances in its progress; besides eight fits, which should have happened within the two years we speak of, it is but a moderate supposition that four more should have been added. At that rate, the Doctor should have had 12 fits, instead of one that he had, in the course of the two years. Recollect also, that this was only a fourth part in violence and duration, of any of his former ones: and by multiplying 12 by 4, the ef-

* This distinction of the two states, and causes, of debility is extremely important, called *direct* and *indirect debility*. As an example, cold produces direct debility, heat, producing first tone, if great, next occasions indirect debility; thus the two extremes meet.

fect of his tonic plan will come out to be a reduction of the disease from 48 to 1.

To such certainty has he attained in the knowledge of every thing that is either hurtful or serviceable in the management of himself for the prevention of fits, that he can bring on a small fit any time he pleases, by any one of the articles of regimen that have hitherto been depended upon as the only means of cure. Oat-meal porridge had been particularly specified to him as a very proper article in diet; and he had been advised to depend as much as possible upon this meal. But though it was very agreeable to his taste, from his having been much accustomed to it in his youth; by taking "porridge and ale at "any time over night, he is sure next morning "of bringing on all the symptoms of indigestion and crudity in the stomach, with looseness of belly, that lay the foundation of a fit of "the gout." And, "if he does not prevent "further consequences of this hurtful article of "diet, by taking his breakfast early, even against "his appetite; by either premising or subjoining to his breakfast a pretty strong cordial; "and even repeating that, if the continuation of "the symptoms should require it; the disease "will proceed till it assumes every symptom of "a formal and regular fit of the gout. There "are, besides loss of appetite and sense of crudity "in the stomach, nausea rapidly increasing till it

 "terminates

"terminates in vomiting; with pain somewhere "about one of his feet, and even evident inflam-"mation. All this concourse he can prevent, "and, when already formed, remove, by the "use of what he calls his *quickly diffusible stimu-"lants*: which are, any wine that is strong and "sound and free of acidity, any strong spirit, "opium, volatile alkali and æther *. There "are others, which, from the analogy of their "resemblance to those we have enumerated, "must operate in the same manner, and there-"fore produce the same effect. They are, "camphor, musk, and some other articles that "may be adduced." Finding any of the mentioned ones sufficient, he has not yet made any trial of these. "Drinking the vin de Bourdeaux "in Leyden some years ago, had the same ef-"fect as the porridge and ale: fruit, especially "apples and pears; all green pottage, especially "cabbage; all the several roots which are used "in diet, especially turnips; and even some "which possess a considerable degree of aroma-"tic quality, as Spanish radishes, all the legu-"mina, except green pease, taken in moderate "quantity, with nourishing animal matter; and "particularly pease-pudding, and pease-soup, "have in their turn brought on fits." The same has been the effect of "all the malt li-

* Vide note, page 144.

" quors, eſpecially ſtrong ale, with a conſider-
" able prevalence of acidity: excepting porter,
" eſpecially when approaching to ſtaleneſs; for
" bottled porter, or any porter in which any
" conſiderable fermentation is ſtill going on, ap-
" proaches to the effect of the other beers."

Theſe are principal particulars, which we think proper to take notice of at preſent. Suffice it to obſerve in one word, " that the whole
" liſt of vegetable articles, except thoſe forms
" of vegetable matter which poſſeſs a high de-
" gree of aromatic quality, and are therefore
" uſed in ſmall quantity, and all ſour, ferment-
" ing, or vapid drinks, are in one degree or other
" cauſes of the gout." With reſpect to " water,"
the reſult of his experience was, " that, in the
" intervals of the gout, when a perſon is in his
" ordinary health, water, which is of itſelf a de-
" bilitating power, if conjoined with nouriſhing
" animal food is of no diſſervice, but, at any
" time, in a podagric diatheſis, conjoined with
" vegetable matter, it will add to the ſum of de-
" bility occaſioned by that kind of diet. And
" when the ſtomach is weak, either as prelud-
" ing a fit of the gout, or implying a ſtate of
" indigeſtion of any ſort, pure water, uſed as
" drink, and more certainly in perſons who have
" been accuſtomed to generous drink, adds great
" force to the effect of the other hurtful powers."
This concluſion is derived from the moſt ſure

 induction

induction of facts. "The doctor used one "year upon water, during his confinement to "vegetable food: he lived for another year on "it, when he betook himself to his tonic regi-"men. In this case he drank water with his "meals, and abstained from all stronger drink, "without any hurtful effect, whereas, in the "other case, he never used water to any ex-"tent, but with the most chilling, debilitating "effect."

Infinite is the advantage that has accrued to the profession, from this well conducted scrutiny into every article of diet in ordinary use among mankind. The effects of it before, had not only been judged of at random, and therefore very false conclusions been drawn with regard to them, but such has been the capricious consequence of chance, that over-ruled this whole affair, that it has most inexplicably happened, that two general conclusions, diametrically opposite to the truth, have been the final result of all speculation on the subject. One of these conclusions was, that vegetable food, as a part of antiphlogistic regimen, and watery or no drink, have been supposed the only proper means of preventing fits of the gout; and full stimulant diet the only ones productive of them. "The contrary," says Dr. Brown, "has been proved to be the truth, by an "ample induction of facts, that all future obser-"vation will for ever confirm and justify."

Besides this account of diet in the conduct and cure of the gout, we have only to add, from the same authority to which we owe the former detail, " that though vegetable matter has the " hurtful, and animal, the beneficial tendency, hi- " therto ascertained; yet, when the stomach is " in its ordinary healthy and vigorous state, a " certain portion of vegetable matter may be " usefully conjoined with full meals of animal " matter. For our author perceived, that the " most filling and stimulant matter of that kind, " without such a proportion of vegetable, failed in " producing its best stimulant effect" He felt in himself, and inferred from the universal practice in meals, " that without a portion of bread, " and certain other vegetable matters, satiety " was never obtained: that there was always " what, according to vulgar perception, would " be called a *want in the stomach*." He studied this affair; and the result of his study was, " that " there was a certain quality in alimentary mat- " ter which bore a certain relation to the exci- " tability in the stomach *;" This relation, he perceived, was a property in the alimentary matter, from its " kind," not its " quantity," to operate upon the " excitability," and produce " excitement." Such, he discerned, was the effect of all matter in so far as it is alimentary;

* El. Med. vi. vii. viii. ix.

but chiefly of "animal matter," [illegible] im-perfectly of " vegetable." And hence it is, " that the former is ſo well, and the latter ſo ill " ſuited to anſwer the purpoſe of aliment. But " after obtaining the beſt effect that could be " procured from animal-aliment, the moſt pro- " per in kind, and adminiſtered in the moſt ex- " act quantity, there was ſtill a ſtimulus want- " ing, ariſing from a different mode of opera- " tion." While he obſerved " that animal ali- " ment might be rendered ſo rich in quality, " that the full ſtimulus ariſing from its quality " might be obtained in a ſmall bulk, ſtill the " meal would not be ſufficiently gratifying with- " out the taking in of ſome matter, which add- " ed nothing to the other operation but an ef- " fect ariſing from bulk. Eggs, for inſtance, are " highly nutritive; and greater nutrition ſtill may " be procured from jellies and rich ſoups, but no- " body would be gratified with meals conſiſting " of theſe alone." Hence I learned, " that be- " ſides the ſtimulus of aliment ariſing from its " quality, which he therefore denominated *di-* " *rect*, that another ſtimulus ariſing from quan- " tity * was neceſſary; to this he gave the ap-

* How little is this ſuſpected to be the Brunonian doctrine. Man is fooliſhly repreſented by ſome Brunonians to want only *ſtimuli*, and no allowance made for the neceſſary waſtes of the ſyſtem. Dr. Brown on the contrary has never forſaken the ſpirit of a true philoſopher.

" pellation

" pellation of *indirect*. As the direct ſtimulus " aroſe from a certain quality, he ſaw it required " certain matters poſſeſſing that quality in order " to obtain it. Theſe matters he found to be " *animal*, poſſeſſing the quality in a high and " ſuitable degree; and *vegetable matters*, poſſeſſ- " ing it in a very low and imperfect degree. " While the latter, therefore, were diſqualified, " as we have ſaid above, from affording the di- " rect ſtimulus, becauſe nothing but bulk, giv- " ing diſtenſion, was requiſite to the indirect, he " ſaw that they would be ſuitable enough to ef- " fectuate it, however low they might be in the " ſcale of direct ſtimulus that they contained, or " perhaps though they contained none at all." He ſaw " it was certain forms of matter, agree- " ing in containing in common the quality " of direct ſtimulus, that anſwered the firſt pur- " poſe; but that any matter, whether its direct " ſtimulus was weak or wanting altogether, pro- " vided it was not diſagreeable to the ſtomach, " would ſuffice for the ſecond." Of this principle, ſo accurately explained and clearly ſtated, the application to practice was, " that vegetable " matter, in moderate proportion, ought to be " united with ſuch a proportion of animal, as " would prevent bad effects ariſing from the for- " mer by the predominancy of its ſalutary ſtimu- " lus: that, whenever a perſon found his ſtomach

" ſtrong,

" ſtrong, and his ſyſtem in perfect health he
" need not torment himſelf by over anxiety to
" avoid exceſs in the vegetable matter; and, on
the contrary, that he may follow his inclination
to a certain extent. But, upon the firſt feel-
ing of indigeſtion, he inſiſts that too much cau-
" tion cannot be uſed; and he contends, that the
" only abſolute ſecurity is nearly a total abſtinence
" from every kind of vegetable matter."

In the courſe of this inquiry into the effects of all the ſeveral articles of diet, our author extended his obſervation to other parts of management. He went into the conſideration of " ſleep" and of " exerciſe," and varied and repeated his experiments on both. " Too little ſleep, under his
" vegetable diet, he found a moſt prodigiouſly
" hurtful power. The diet weakened him ex-
" ceſſively, and produced the effects we have
" mentioned: and this weakneſs was of the direct
" kind. His ordinary corporeal and mental oc-
" cupations proved fatiguing, and therefore alſo
" weakening; but this weakneſs was of the in-
" direct kind. The former originated from in-
" ſufficiency of ſtimulus; the latter from the ſti-
" mulus being carried to exceſs under the conco-
" mitant circumſtances, and therefore rendering
" the ſyſtem unfit for receiving excitement from
" it, by exhauſting the principle upon which all
" the ſeveral ſtimuli only can operate in produc-

" ing

" ing excitement, viz. the excitability *. As part
" of the debility was of the indirect kind, arising
" from the stimulus of mental and corporeal ex-
" ercise exhausting excitability, and therefore sus-
" pending excitement, a sufficient quantity of
" sleep operated by suspending the excess of sti-
" mulus which produced this suspension of ex-
" citement, and therefore by giving occasion to
" the restoration of the excitability, and an op-
" portunity to the exciting powers, remaining in
" the system, to act with effect. Too short sleep
" preventing the completion of this process, al-
" lowed the indirect debility to remain, in con-
" sequence of the excessive stimulus, exhausting
" the excitability, being not sufficiently suspend-
" ed." This is the explanation of a fact that he had repeatedly experienced, viz. " that short
" sleep is one of the most powerful causes of de-
" bility in general, and of gout in particular."

With respect to " exercise," he found, " that,
" either when very intense or unusual, it also
" proved very powerful in renewing fits of the
" gout." It has been said, that the first fit which appeared after the institution of the tonic plan of regimen, was induced upon the occasion of his having, contrary to usual practice, walked a great deal in the course of a day or two. And

* See the El. Med. ix. x. xv xvi. xviii. xix. xxi. xxii. xxiii. xxiv.

he has experienced, both before and after that time, that the fatigue of walking is very powerful in bringing on fits. That walking, in certain circumſtances, could bring on fits of the gout, is a fact not unknown to former phyſicians But as it claſhed with another fact directly oppoſite to this, which was, that indolence and ſedentary life, conjoined with full and ſtimulant living, was the principal circumſtance that induced the gout at firſt, and was therefore ſuppoſed ſtill more certainly to renew the fits of the diſeaſe; from this ſeeming contradiction of effect and cauſe, phyſicians were all thrown into an inextricable perplexity; the ſolution of which, upon the Brunonian principles, is perfectly eaſy. " Exerciſe, where " habitual, and rendered ſafe by ſuch habit, and " never carried to an immoderate degree, upon " the whole, affords a ſtimulus highly requiſite " to human health, and ſuited to prevent all diſ- " eaſes of debility, and the gout among the reſt. " The proper degree of it, producing this effect, " depends not more upon moderation of its uſe, " than upon a proper degree of ſtimulus being " thrown in in the form of diet, to enable a per- " ſon to endure it and be benefited by it. When, " therefore, neither too much nor too little of the " ſtimulus of food and drink is taken in; or, " when any error in either of theſe extremes has " been committed, if this has been corrected by " increaſing or diminiſhing the exerciſe in pro-

" portion

" portion to the deficiency or excefs of the other " ftimulants; exercife, fupporting egeftion, and " otherwife ftimulating, fo adjufted to the quan- " tity of ingeftion taking place, proves one of " the moft natural and permanent ftimuli that " can be applied to fupport human vigour, and " prevent difeafes. But the deftruction of this " balance, in confequence of too high a ftimu- " lus from diet conftantly going on, and pro- " ducing a gradual tendency to indirect debility, " and a habitual deficiency in exercife, which is " a means of direct debility, as implying that the " proper degree of ftimulus which it is calculated " to give, is habitually withheld, is liable to pro- " duce other difeafes of direct debility, and the gout " among the reft." Hence it is that the luxurious and indolent are the principal, and almoft only, victims of this and fimilar difeafes depending upon debility, the chief and prevalent part of which is of the indirect kind. "Again, when the " ftimulus of diet is employed in a very low " degree, and that of exercife carried to a very " high degree, which is a ftate of debility, the " prevalence of which is of the direct kind; " then it is that perfons will not fall into the " form afthenic difeafe, to which the denomina- " tion of *gout* is given; but they will fall into " other difeafes of an equal, or even more per- " nicious, tendency. Dyfpepfia, diarrhœa, fome- " times conjointly, feldom feparately, fcirrhus, " dropfy, or even putrid fever, and fuch like

" forms

"forms of morbid ſtate, depending upon direct "debility, will be the conſequence of ſuch hurt-"ful management. The diſeaſes prevailing "among the poor people, who are commonly "ſtarved, and oppreſſed with aſſiduous exceſſive "labour, afford many inſtances of diſeaſed ſtate "originating from this ſource of direct de-"bility." This matter, therefore, placed in the light in which we have ſet it before our readers, will explain both the cauſe of the error of phyſicians in ſuppoſing exerciſe, without limitation, to be an effectual means of preventing the gout; and it will point out the occaſion of their embarraſſment, upon finding that after a perſon has fallen into the gout, any unuſual exerciſe will bring back attacks. "If exerciſe be properly adapt-"ed in its degree to the ſtimulus of diet thrown "in, no diſeaſe will happen. If the balance be "deſtroyed, as in the firſt-mentioned caſe of er-"roneous management, the gout will not hap-"pen, but other forms of this ſame kind of diſ-"eaſe will; which is a verbal, but no real differ-"ence. In the ſecond caſe, the gout will hap-"pen; implying, that a diſeaſe of debility has "appeared in conſequence of the means neceſ-"ſary to the ſupport of life having been car-"ried too far, with the effect of inducing debi-"lity, upon a principle now often explained, "and by this time ſufficiently familiar to our "reader: for we muſt take it for granted, that,

"from

"from the explanation already given, the prin-
"ciples of this doctrine are sufficiently cleared
"up, at least in so far as we have occasion to
"touch upon them." With respect to exercise we conclude, "that uniform, equal, and gentle
"exercise, conjoined with the plan of regimen
"detailed as above, is the proper method of pre-
"venting fits of the gout; but that excessive
"exercise, or a sudden transition from sedentary
"life to a degree of it not immoderate in itself,
"but rendered so by abstinence from the due de-
"gree, is alone, and more certainly when con-
"joined with the other hurtful powers, a most
"powerful cause of the return of paroxysms."

As the gout is a disease of debility pervading the whole system, but more especially affecting what the Doctor calls the internal and external surface of the body; that is to say, the stomach and the rest of the alimentary canal, and what is known to every body by the appellation of *external surface*: in the former of which it manifests itself by all the symptoms of indigestion and a weakened state of the intestines; and is as discernible in the latter by a sense of languor perceptible in every part, where it shews itself by that feeling of which every person can conceive an idea from the recollection of his feelings, especially in his thighs and legs, either when he begins to be under the influence of sleep, or when he is awaked from sleep, before it has had its full course. It is therefore next to be observed,

"that

"that besides taking a proper quantity of sleep, "and supporting the internal surface by proper "dietetic materials, the tone of the external sur-"face should every where be sustained by the "application of a proper degree of tempera-"ture. And as the legs and feet are peculiarly "liable to the prevalence of debility, they should "therefore be carefully kept warm. Silk stock-"ings, unless used as upper ones, should be "avoided, especially in winter, by every po-"dagric, and worsted ones, with flannel socks "next to the feet, only used." To illustrate the propriety of this direction: among other hurtful powers by which he can bring on a little fit of the gout at any time, he can produce the same effect "either by curtailing his sleep, or exposing "his body, especially his legs and feet, to cold "alone, and more certainly cold conjoined with "moisture."

After thus fully instructing himself in the nature, cause, and cure of the gout, and finding himself highly rewarded for his discovery by the great abatement of pain and distress which he had experienced in consequence of a different practice, he rested satisfied with the progress he had made in the knowledge and treatment of this disease, and thought it unnecessary to give himself the trouble of shortening or alleviating fits when they occurred.

Difficulties, however, still remained, which his

pupils, desirous that the doctrine should be as perfect as possible, wished to have every object removed, and which his opponents could urge against it. It was his duty to gratify his pupils; and it was the common interest of the cause to silence his adversaries. The manner in which he did so claims attention. He had brought on a slight fit of the gout by unusual exercise in walking. This was an opportunity for making an experiment, which was to decide the whole controversy. A person called for him before dinner, who was in the way of business, and insisted upon his being social, which might have led him to drink more than he wished in the forenoon, unless he had been particularly on his guard, until he had collected half a dozen of his principal pupils * to dinner, and drank with them till he only, in consequence of what he had taken before, was somewhat affected. He told them he had planned some degree of intoxication in order to explain many inflammations, which were universally understood to be accompanied with, or to depend upon, phlogistic diathesis. Before the application of the stimulus we speak of, he had not been able to put his inflamed foot to the ground, and had supported himself, in any little motion that he

* These gentlemen were, Dr Stephens, Dr. Wainman, Dr. Byam, Dr. James Campbell, Mr Richard Coddington, Mr. John Howel, and Dr. Jones.

chose to make through the house, by his sound extremity, assisted by the use of a staff. But before he dismissed his company, he recovered the perfect use of his affected leg. The inference from which is plain, viz. "that the inflammation "in the gout does not depend upon excessive vigour occasioned by the excessive use of stimulant powers previously applied, but upon a "state of the system diametrically opposite to "that, viz. debility induced by a previous application of weakening powers; and that its cure "is not to lower the vigour of the system by the "use of debilitating or insufficiently stimulating "powers, but to raise it by the use of powers "highly and quickly invigorating." And the benefit redounding to the curative part of this, and other diseases, accompanied with a similar kind of inflammation, must be obvious to every one. The fact is not limited to the case of the gout *, though it would remain still a highly meritorious

* The general inductions of Dr. Brown are the most exceptional parts of his doctrine. It does not accord with common reasoning to suppose that all diseases have the same origin, although all stimuli have an undoubted ultimate similar effect on the living fibre, that of inducing debility. To obviate this is all that we can do, when the causes of disease are beyond our reach, but as medicine advances these may be discovered, and the true scientific practice established Thus if a person was to take a powerful poison, who would not rather expel or correct it, than obviate its effect

ritorious one if it were ſo; it graſps many other caſes to be enumerated.

As the gout, as we have before ſhewn, affects the alimentary canal, and eſpecially the ſtomach, and in its courſe is attended with ſymptoms ſimilar to thoſe that occur in dyſpepſia; Brown was deſirous to know if there was any affinity betwixt theſe diſeaſes, and he found that dyſpepſia

fect on the frame? Should a perſon ſwallow a large doſe of opium, the firſt indication of cure would be to expel it from the ſtomach. A child was in ſeeming agony, and ſhewed evident marks of great excitement. The Brunonian bled and bliſtered and purged, to reduce the ſyſtem. It was found that a pin had run under the ſcapula; ſurely the firſt indication was to take out the pin, afterwards to correct the ſthenic diatheſis. So in the gout, the debility and inflammation is occaſioned by ſome cauſe, and chemiſtry perhaps hereafter will diſcover that this is a ſuperabundance of *phoſphoric acid*, to be corrected by alkali, ſulphur, and whatever diſoxygenates: for in gouty patients, during the paroxyſm, none or very little phoſphoric acid can be procured from the urine; and the ſweats, and other excretions ſhew a ſuperabundance of this acid principle; the ſame alſo is ſhewn from the florid complexion. The formation of calculi in gout proves alſo the ſuperabundance of phoſphoric acid, or the defect of the kidneys in ſtraining it off. Rheumatiſm is ſaid to be allied to gout, and probably ariſes from the ſame cauſe, the ſuperabundance of phoſphoric acid; and hence the benefit in this diſorder ariſes from drinking the mephitic alkaline water. The ſtone and diſorders of the kidneys bear the next analogy; and the reader will perceive that this doctrine of theſe diſeaſes, if true, is a great advance on the Brunonian principles.

 equally

equally with gout depended on debility, and yielded to ftimulant remedies *. Nay, he afterwards afcertained, that all fpafmodic convulfive difeafes of the alimentary canal †, and above two thirds of the difeafes of children, were of the fame ftamp.

Continuing his inveftigation of fpafmodic and convulfive difeafes, when they occupy the organs of voluntary motion; he difcovered that their nature was alfo the fame in kind, but only greater

* An emetic and purge fhould be premifed before the exhibition of tonics, to clear away the mucus, which is apt to collect in weaker habits, and our remedies then get at the *living fibre*. It is thus we rake away the duft, before the external air can have a due effect on the fire.

† Children have frequently a difeafed fecretion of bile, which appears in green ftools. This irritates the bowels, which throw out mucus. Part is abforbed, and the mefenteric glands become difeafed. A fcrophulous conftitution enfues, with the whole melancholy catalogue of evils, as worms, chronic inflammation of the eyes and eyelids, white fwellings, &c. All this dreadful train of fymptoms from one original ftock might have been avoided by purging, as often as the ftools in infants appear *green*, and afterwards by giving fome tonic. But the *purging* is moft effential. I hope what I have here faid will be attentively confidered by mothers and practitioners, perfuaded of its high importance as a practical obfervation, prevention of difeafe being always preferable to cure. The Brunonian practice employed here *without occafional evacuants* would fpeedily deftroy, and indeed has been the deftruction of thoufands.

in degree ; as they are exemplified in the ſpaſms and pains, that occur in various parts of the external ſurface of the body, and in epilepſy, and in tetanus, themſelves. Hence he diſcerned, that a vaſt number of affections, in which upon the ſuppoſition of their being inflammatory, no limits had been ſet to the uſe of the lancet, inſtead of ariſing from an over-proportion of blood and exceſſive vigour, or any other ſuch cauſe, depended upon an under-proportion of that fluid, and other cauſes of debility, and were to be cured, not by bleeding, or any other evacuations, but by filling the veſſels, and reſtoring the ſtrength of the whole ſyſtem.

At firſt, for the purpoſe of removing fits of the gout, he went no farther than the uſe of wine, and other ſtrong liquors, with nouriſhing food, that is, ſeaſoned meat, and kept the more powerful remedies in reſerve. But, for many years paſt, his ſurpriſing ſucceſs in the uſe of the latter, has enabled him to find in opium and ſome other ſtimuli, the ſecret of repelling the fits of the gout as often as they returned, and, at the ſame time, of re-eſtabliſhing the healthy ſtate, a ſecret that has hitherto been ſo much wanted and deſpaired of*. This he has often effected both in himſelf and in other perſons. It is now ſeven years ſince he has been able entirely to prevent the return of this diſeaſe.

* Vide Note, page 144.

By ſimilar inſtances in actual practice, he found that bleeding diſcharges, which are called hæmorrhages, do not depend on plethora and vigour, but upon penury of blood or debility ariſing from ſome other ſource, and therefore he rejected them from the number of ſthenic diſeaſes *; for he ſaw, that bleeding, other evacuations, abſtinence, cold, and ſedatives, as they are called, proved hurtful; and that the ſtimulant plan of cure alone was ſucceſsful. Even wine and brandy, which had been thought ſo hurtful in thoſe diſeaſes, he found the moſt powerful of all remedies in removing them. Hence he learned, that in all the diſeaſes, in which others had ſuppoſed there was abundance of blood, there was a deficiency, that the real cauſe of theſe diſeaſes was debility, ariſing from defect of blood and other ſtimuli; and that ſtimulants, given in proportion to the degree of the cauſe, were the proper remedies.

By the light that thus beamed in from practice, he ſaw, that the cauſe and cure of fevers, both intermittent and continued, were the ſame.

With reſpect to the inflammation, real or ſuppoſed, occurring in the end of typhus, in a concourſe of ſymptoms of the higheſt debility compatible with life, manifeſted by ſigns of excite-

* Sthenic diſeaſes, as will be afterwards explained, are ſuch as depend upon an exceſſive application of the ſeveral powers that otherwiſe produce health.

ment in the head, and particularly raging delirium, an equal fatisfactory experiment as that made by Dr. Brown on himfelf in a fit of gout, proved the application of the fact in queftion to that cafe. A friend of mine, fays Dr. Jones, lay in a fever. He was treated in the ordinary way, excepting that he had a fcanty allowance of wine; which is a practice beginning to take place among the moft violent and powerful oppofers of Dr. Brown, in confequence of thefe practitioners perceiving, from its fuccefsful ufe in his own hands, and in thofe of his followers, that it will obtrude itfelf upon them at laft. But their prejudices in favour of the old practice, with which they have been early imbued, oppofe an infurmountable barrier to their ufing it, and the other diffufable ftimulants, in that liberal and copious manner in which only it can be of ufe. Notwithftanding, therefore, the wine that was given him, the fymptoms of weaknefs went on and increafed, till it was plain, even to a good woman who attended him as his nurfe, that death muft be the confequence of the plan of cure, hitherto purfued, being further continued. He had all the fymptoms of approaching death; and from which fhe, in a large courfe of practice in her way, had never feen one recover. This declaration fhe made to me in the prefence of the landlady of the houfe. So certain was their expectation of his death, that the clothes in

which he was to be interred had for some time before that been every night laid out. The physicians who attended him suspected that there was a *Brunonian*, as they call the followers of the new doctrine, in the number of the friends who visited the patient; and if he ventured to prescribe any thing for him, that it would be according to the doctrine which Brown taught, and therefore very different from theirs. The nurse was therefore very strictly charged, upon the pain of all mischief which they could do her in her way of business, to see their prescriptions executed, and to admit of no other. That such was the threatening conversation they held with the woman, I am warranted to infer from her own assertion; that she had hitherto prevented my interference, because her means of living were at stake. But now, as nothing but death presented itself to her expectation as the result of the ordinary plan of cure, she thought herself justified to God, in allowing the new mode of cure as fair a trial as the short space of life that the patient seemed to have before him would admit of.

To explain my assertion of her not thinking herself justifiable to man, her words were the following: "I shall give your doctrine a complete
" trial, upon this condition only, that you will
" keep the secret. My bread depends upon it.
" I am ruined if what I am about to do be di-
" vulged. And if ever it comes out, I tell you
" before-

" beforehand, that I will deny the whole matter." In consequence of this paction, opium in large quantities, because spirits and wine could not be poured in, was administered from 12 o'clock in the day through the course of the night. The consequence of which was, the next morning pretty early, when the physicians visited him, that they declared him better, as I am told; and, as a proof that they thought so, ordered him chicken and chicken-broth. He remained in this happy and unexpected state till the afternoon about four, when he was seized with a raging delirium. This alarmed the nurse and myself. I then consulted Dr. Brown what I should do with my patient. He was not alarmed for the nature of the thing, but for the consequences, if the former plan of cure were returned to, which might prove a cause of the patient's death, and might afford an opportunity to other physicians to impute that death to him. The rumour, spread among the people in consequence of such a report from physicians of reputation and influence, might, he easily perceived, terminate in his ruin. I told him the nurse wished to see him; and he desired her to be brought before him. She asked his opinion of the case; and his reply was, " That there was " scarce a physician any where, and more certainly those attending the patient, who would " not assert, that the present formidable symptoms were the effect of the high stimulant " powers which had been administered to him the

" night

" night before. But he added, that if the ſame " mode of cure were not continued, the patient " would certainly die of a very different affec- " tion from that which they would contend it " was. He endeavoured to aſſure her, that " there was either no inflammation in the caſe " at all, or that it was a very different affection " from the inflammation that phyſicians were " acquainted with: That, inſtead of requiring " bleeding and other evacuant antiphlogiſtic " means, it required the very ſame treatment " which had been laſt employed. He appealed " to the beneficial effect of that treatment in ſup- " port of his opinion; and he aſſerted with con- " fidence, that the intermiſſion of the ſtimulant " powers through the courſe of the day was the " cauſe of all that had happened: for ſhe told him " ſhe had given nothing of that kind during the " day, from the full perſuaſion that the patient's " diſeaſe was removed. The purport, in ſhort, " of all this, is, that the preſent affection was a " diſeaſe of debility of the whole ſyſtem, predo- " minant in the brain in conſequence of the " great ſinking of ſtrength, which conſtantly " follows a total ceſſation of the uſe of ſuch " highly ſtimulant powers; and that a ſinking " was a conſequence of the cauſe aſſigned, in " every ſtate of the human body; that dejection " of ſpirits, anxiety, ſadneſs, and every ſymp- " tom of diminiſhed vigour, were the ordinary

" results of a quick transition from debauch to
" abstinence. He begged, therefore, *as the life of
" a fellow creature was at stake*, and as she had
" been so late a witness of the good effects re-
" sulting from the method of cure, the continu-
" ance of which he still recommended; that she
" would not allow prejudice, and impressions
" from false theories of physicians, among whom
" she had been conversant, to prevail over the
" high probability of success from this mode of
" cure." He dismissed her, after obtaining a promise that she would continue the plan of cure in question. The prejudice we have spoken of had prevented her from completely fulfilling her promise; as appeared by the consequence next day: when I went back to the Doctor, and told him that the patient's raging delirium was now over, in consequence of an imperfect renewal of the stimulant plan of cure; that he was now seized with a coldness of all his extremities, proceeding rapidly to the more centrical parts of his body. "Now," said he, "is the time to ply
" the most powerful stimuli; as the nurse, from
" a thorough conviction of this being a symptom
" of instant death in all the cases that she had
" ever seen, can possibly have no objection to
" this plan of cure, after constantly finding every
" other fail. She might have been afraid of it
" during the continuance of the delirium; but
" that apprehension must vanish in the present

" case,

" case, in which it must be natural to her to " expect, that exciting the system promises the " only cure of a case that must evidently ap- " pear to her to depend upon a sinking of the " vital energy." She was accordingly very readily prevailed upon to throw in very plentifully the strongest cinnamon spirit and rum. The effect answered the Doctor's prognosis. Next day the patient was better, and never had another relapse.

This cure gave great vexation to the attendant physicians, and all their partizans. Without giving Dr. Brown the least opportunity to vindicate himself from their accusations, by spreading these through all the numerous circles of their friends and his enemies, they had very near ruined his character as a physician, and as a man. They did me the honour, continues Dr. Jones, to involve me in his cause. Their accusations against us both were, " that we had clandestinely, and " without authority, interfered with their pa- " tient, and thwarted their method of cure." They had consulted lawyers, to raise a prosecution against us. They had deliberated about bringing us before the tribunal of the college of physicians. In short, nothing less was their aim than the ruin of an honest man, and of a most beautiful and numerous family, for saving a man's life. The news of this reached him, and he received certain information of every thing that the most

most active perſon in the plot was doing againſt him; of whoſe folly and malice the reſt made a handle. And, laſt of all, ſuch was their inconſiſtence, that they made an attempt to diſprove that our method of cure had ever been employed. One of them held private conferences with the nurſe; and after employing every mode of intimidation which her obnoxious ſituation ſuggeſted, he prevailed on her, as he ſaid, to deny that any part of our mode of cure had ever been adminiſtered by her. She was ſaid to have confeſſed, that *ſhe had deceived me*, to get rid of *my importunities*: and they even circulated a ſtory that I offered her a bribe. All this was weakneſs and impotence. It was devoid of truth: it even wanted coherence. And the whole fact hung upon the teſtimony of a poor woman; who, if ſhe acted the part that was alleged, was impelled to it by her ſituation in life, indigent and at their mercy. The reader will perceive, through the whole of this proceſs, a ſhameful unfairneſs and meanneſs, unworthy of a ſet of men, whoſe profeſſion, continues Dr. Jones, if they executed it with liberality, would entitle them to the rank of gentlemen. It was unfair to ſpread the groſſeſt inſinuations againſt any perſon's character, without firſt confronting himſelf with the accuſation. It was mean, and implied conſciouſneſs of the badneſs of their cauſe, to hold private conferences with a ſilly dependent old woman, in the abſence

of thoſe whom it ſo highly concerned to have been preſent to enſure fairneſs. Circumſtantial evidence, the beſt of all evidence, is totally wanting in their tale; deep malice can be proved, which makes further againſt their candour and veracity. And who, in his ſenſes, under theſe circumſtances, would place any dependence upon the teſtimony of a woman in the ſituation deſcribed, or oppoſe it to a chain of conſiſtent teſtimony and internal evidence that preſents itſelf on the other ſide of the queſtion? The reader will recollect the anſwer to the woman's real, or ſuppoſed affection, of her *deceiving me*, That ſhe declared before the landlady of the houſe, that ſhe would make a full trial of my mode of cure. And I muſt be allowed to affirm, that I ſaw the firſt doſe adminiſtered. It was alſo before the ſame other woman and myſelf, that, upon finding the patient ſo perfectly relieved next morning, ſhe declared that I was the *only doctor*, for that I had ſaved a life that infallibly muſt have periſhed.

The firſt evening of the commencement of our cure, after two exceeding large doſes of laudanum had been given, the patient, who had not ſlept for 48 hours before, was enjoying a moſt refreſhing ſleep, and ſo much better in the other ſymptoms, and particularly in the reduction of his pulſe from 112 to 92, that one of his attending phyſicians owned before me at the bed-

ſide,

ſide, that he was even then ſurpriſingly altered for the better. Further, will this nurſe *deny*, that ſhe came to Dr. Brown's parlour along with me, and had the conſultation about what was to be done with the new ſymptom of delirium? And is it poſſible, that ſhe can have *forgot* the purport of what the Doctor ſaid on that occaſion? that ſhe told him ſhe had been equally ſurpriſed at the wonderful relief obtained in the morning, and alarmed at the formidable relapſe in the afternoon? At this interview none were preſent with her but the Doctor and myſelf. But it was known to ſeveral, and particularly to Mrs. Brown and Dr. Wainman, that ſhe had been there. And all the ſubſequent ſteps of the cure were every day communicated to ſome particular friends; who, if this ſhould any more be called in queſtion, are ready to give their teſtimony to the truth of this whole proceſs as we have related it. I myſelf attended this caſe from the beginning to the end of it, at leaſt four or five times every day; and I do here give my moſt *ſolemn declaration*, that the whole relation here made to the reader is truth.

It is not amiſs to take notice of a circumſtance that occurred early in the diſeaſe, in further corroboration of what has been ſaid. One of the phyſicians, who continued his attendance afterwards, was ſome how or other called in againſt the patient's conſent. He ordered him tartar

emetic, which the patient by my advice refuſed; in place of it, the moſt diffuſible penetrating and powerful ſtimulants were given in large quantities, and with great ſucceſs. The phyſician returning next day, perceived him much relieved. And when, the next day, he was going to impute the merit of the ſervice done the patient to the tartar emetic which he had ordered, he was then told the patient had refuſed it, and in place of it taken a large doſe of laudanum, vol. alkali, and cinnamon water. Upon hearing that, he ſhook his head; meaning, according to the practice of the oppoſers of the new doctrine, that this ſignificant nod ſhould paſs among the by-ſtanders, as a proof that there was ſome miſtake in the caſe: but a paleneſs was perceivable in his countenance; and concluſions were drawn from that, which over-balanced the effect of the *nod*. To do juſtice to every man, and prevent miſtake, as there were two phyſicians attending this caſe, the phyſician we have laſt mentioned was not Dr. Monro. By and by, a little wine was ordered, but not by Dr. *Duncan*.

I ſhall finiſh this vile affair, continues Dr. Jones, by vindicating the character of my worthy preceptor, as a man and as a liberal phyſician. Few perſons would think it a crime in any one, if he ſaw another *killing* a man, and had it not in his power to avow himſelf his deliverer, *to ſave his life* even in the moſt clandeſtine manner. This ſimile,

ſimile, however, applies not to the preſent caſe. I attended the patient in queſtion, from the beginning of his fever till the conſummation of his cure; and I was about him before any practitioner was called in. I from time to time conſulted the gentleman I have ſo often ſpoken of. He gave his opinion of the caſe, as one in which I was more properly concerned than any other perſon about the patient. I was his friend; I had done him ſervice before. One of the phyſicians was called in by no other authority than mine: the other, by none at all, at leaſt not by mine; and, as I have before obſerved, againſt the patient's conſent. My reaſon for calling one of the phyſicians was, that as I knew from his Lectures he was no friend of the ſpaſmodic doctrine, I hoped he would lay down a different plan of cure from the evacuatory debilitating one, which that doctrine ſuggeſts; that he would have nothing to do with the moſt pernicious and deſtructive of all powers, which upon any occaſion have been ever employed as remedies in fever, *tartar emetic* *; and laſtly, that he would, upon a fair and candid

* Dr. Brown and Dr. Cullen are no more. Their reſpective doctrines will now be canvaſſed with temper. Dr. Brown was certainly right in this caſe in obviating debility by tonic powers; but his doctrine of putrid fever has done equal injury with good: for innumerable are the inſtances where the evacuant plan has ſaved the life of the patient, for the fomes of putrid fever is certainly at firſt

candid recital of the plan of cure, ſo ſucceſsfully uſed by Dr. Brown and his pupils, be induced to concur with him in his ſalutary practice.

Theſe were my expectations; and they were the more ſanguine, that I knew the common method of cure of fever had been for a long time altogether abortive. The deaths of ſtudents, not to ſay of others, for 20 years back, ſo well known to every one, and often ſo unexpected from the mild manner in which the diſeaſe commenced, could not fail to have looſened any man's attachment to that mode of practice, and prepared him for the reception of one ſo much preferable to it in every reſpect, and which had never failed even in the worſt of caſes.

I communicated this reaſoning with myſelf to Dr. Brown. His anſwer was, "That it was very "bad; that I was unacquainted with the in-"tereſted arts of thoſe men; that all their ideas "in medicine, and particularly in its practical "part, were ſo diametrically oppoſite to his,

firſt in the alimentary canal, and even where purgatives are not allowable, glyſters, uſing at the ſame time bark, opium, and wine, may be advantageouſly employed. That *oxygen* is the ſubſtance conſumed by powerful ſtimuli was unknown to Dr. Brown, and confirms the uſe of acids and cold air, along with bark, which his doctrine otherwiſe would condemn. It is intended in the courſe of this work to ſtate the Brunonian doctrines, with thoſe improvements which time has ſuggeſted, as a duty we owe to truth and the public.

5 "that

" that they never could be brought to any ſort
" of reconciliation. And laſtly, he informed me,
" that his doctrine and practice had touched them
" ſo much in their tendereſt and moſt expoſed
" parts, that their paſſion and hatred to him had
" got the aſcendant over their reaſon, ſo that
" there was not the moſt diſtant hope that a meet-
" ing betwixt him and any of them would be
" productive of either harmony or common de-
" cency; in ſhort, that the only plan of conduct
" they could hold towards him was to ſeek his
" ruin.

" Non levia aut ludicra petuntur,
" Sed Turni de vita et ſanguine certunt *."

This he quoted on the occaſion. " However,"
continued he, " *as a man's life is at ſtake*, and as
" he was certain for himſelf that he would act a
" part for which he could acquit himſelf to the
" public and his *own conſcience*, he would meet
" with this gentleman, and hazard every conſe-
" quence of ſuch a meeting; provided I waited
" upon him, and gave him full intimation, that
" he himſelf had been called in by me in expec-
" tation that he would proceed candidly and
" harmoniouſly with Dr. Brown in the treat-
" ment of ſo difficult and dangerous a caſe:
" And," he added, " that I ſhould communicate
" it to this gentleman, that, in conſequence of

* Virgil.

 " great

" great ſervice having been rendered to the pa-
" tient before he fell into the fever, by Dr. Wain-
" man and me as pupils of Dr. Brown, he had
" entertained a good opinion of his abilities as
" a phyſician, and that he was therefore the
" only phyſician whom he had any deſire to at-
" tend him." His conſtant cry, after the diſeaſe aroſe to an alarming degree of violence, was Dr. Brown, with whoſe name he always conjoined mine. This is a truth that cannot be *denied*, and that the nurſe *dare not deny*. This whole converſation paſſed between the Doctor and me, in the preſence of another gentleman; who, after the great noiſe about this cure had commenced, and when the doctor was now accuſed of having clandeſtinely, and even illiberally, interfered in, and counteracted other people's practice, aſſerted before ſeveral gentlemen, that he had heard and could vouch the truth of the whole: and theſe gentlemen are ſtill ready to atteſt their remembrance of this gentleman's declaration. Upon recollection, however, and receiving a very different advice from other friends, who were of opinion, that no good could come of the propoſed meeting and coaleſced plan of cure; that they were too much fettered by their prejudices, and impelled to oppoſition by intereſt; and too ſeverely hurt, from his repeated ſucceſs in a method of cure diametrically oppoſite to theirs, for ſuch mutual advances being made between them

as

as could terminate in any confiftent plan whatever; befides that there was danger of ill blood and indecent conduct in the parties to each other: Induced by thefe confiderations, I never made the propofal to the phyfician we fpeak of, which Dr. Brown had fo particularly recommended to me. This, with refpect to the phyfician of whom I have been fpeaking, muft appear a fatisfactory and honourable vindication of that gentleman from the moft unjuft charge of having *clandeftinely* interfered in, and illiberally counteracted, or attempted to counteract, the practice of other phyficians.

With refpect to the other phyfician with whom we have had concern in this cafe, our procefs of vindication is very fhort. One of the moft accomplifhed gentlemen and intelligent phyficians who have embraced the new doctrine, and who had furrendered a great deal of prejudice againft it to a full conviction of its truth, of which he has at all times made the moft determined and open avowal, Dr. Stevens, was defired by a friend to take advantage of a certain intimacy and connexion that he had with the other phyfician of our patient, and, as a friend, to inform him of the great efficacy of the new practice, and put him in mind of the futility of the common one; and to affure him, that, from repeated experience of his own of the great fuccefs of the former, and from every body's knowledge of the

inefficacy, if not hurtful tendency, of the other, there were not the leaſt hopes of recovering this patient from ſo alarming a concourſe of ſymptoms, unleſs the plan of cure were conducted totally according to the precepts of the new doctrine; to demand his giving it a fair and candid trial, as the deciſion of the controverſy was ſo cloſely connected with the deareſt intereſt of humanity, that of preſerving life, and averting the danger of death. Dr. Stevens replied, That he doubted if he could uſe ſuch freedom with this gentleman, as he knew his opinions to be of a very different nature; and was apprehenſive that he could hardly be induced, by any arguments that could be urged in a ſhort converſation, to alter a practice he had been accuſtomed to for ſo many years, and in which he was countenanced by moſt medical practitioners. He went, however, and ſaw the patient; and reported, that the caſe required the moſt accurate application of the new plan of cure: that there were not the leaſt hopes that either of the attending phyſicians would yield to any part of it. He added, that he deeply regretted the ſtate of phyſic; that he dreaded the event with reſpect to this patient; and that neither he himſelf, nor Dr. Brown, could be of the leaſt ſervice in the caſe, unleſs they were left at full liberty to urge the new plan of cure in the moſt complete manner. It was his opinion,

opinion, therefore, that neither of them ſhould interfere, as it might be attended with very diſagreeable conſequences.

The reader will now perceive, from a cloud of witneſſes, and from a chain of facts, all connected with and ſupporting each other; from a full expoſition of the motives, intentions, and well-known conduct of the opponents of the new doctrine and its author; from the ſurpriſing cure performed in this caſe, compared with the fatal tendency and actual fatality of the ordinary practice, even in the mildeſt caſes; from the corroboration that the new practice in the cure of fevers receives from the ſimilar ſucceſs of it in all other idiopathic, nay, even in local affections; from the known intereſtedneſs of medical practitioners, eſpecially thoſe who teach and take the lead in the profeſſion, impelling them at all times, and never more than at preſent, to oppoſe every innovation, however much it might tend to the improvement of the art, in proportion to its tendency towards the ſubverſion of the ſyſtems or doctrines from which they derive all their profit and ſignificancy: Laſtly, When to all this is added, that the Doctor, *from his love of truth, and profound regard to the higheſt temporal intereſts of mankind, has engaged in an enterpriſe that few men, at any period of civil ſociety, have had either the boldneſs or the diſintereſtedneſs to undertake; in which his reading and obſervation could not fail to inform*

 him,

him, that he was retarding, if not marring altogether, his advancement in his profession, by opposing in the most determined manner every view in physic which its practitioners hitherto had inseparably connected with their profit and honour: from all this the reader, I say, will readily perceive to which side of the dispute he ought to attach his approbation; I mean the dispassionate and disinterested reader.

"*Audi alteram partem,*" says Dr. Beddoes.

The Brunonians loudly proclaimed this case, reported to have been successful, after Dr. Duncan and Monro had given the patient over. Dr. Duncan, roused by these rumours, applied for information to the nurse and her assistant, to Mr. Isaacson himself, to the mistress of the house where he lodged, to Mr. Edmund Goodwin, and Dr. Monro.

In his letter he has published their respective attestations and depositions upon oath: from which it would appear that the clandestine proposals were rejected, and that only one unsuccessful attempt was made by the negociator himself to administer a dose of his diffusible stimulants. According to the nurse's testimony, Mr. Jones on her first refusal declared, if she "would do as "he desired her, Mr. Isaacson would give her a "handsome reward when he recovered—that "the medicine he wished her to administer was

"a bottle

“ a bottle of double rum, of which ſhe was to
“ give him a glaſsful, with fifty drops of lau-
“ danum in it, the firſt night; and another glaſs-
“ ful, with one hundred drops of laudanum in it,
“ the ſecond night, if the firſt doſe ſhould have a
“ good effect. To this propoſal ſhe anſwered,
“ that if ſuch medicines were adminiſtered to
“ Mr. Iſaacſon in the ſtate in which he then was,
“ he would not recover to reward either her or Mr.
“ Jones. To which he replied, that ſhe was a
“ damned fool for refuſing, and that he would
“ give her two guineas out of his own pocket,
“ if ſhe would do it. She ſaid, *that if the beſt*
“ *graduate in Edinburgh would give her her*
“ apron full of gold, ſhe would not.” This woman depoſed moreover that one evening, while ſhe was employed apart, ſhe heard Mr. Iſaacſon ſuddenly cry out, “ Good God, what “ is this? It is laudanum! I am poiſoned!” She then obſerved Mr. Jones by the bedſide with a tea-cup, containing ſome liquor, in his hand, which he ſet down on the table, requeſting the landlady to give it to Mr. Iſaacſon at a proper opportunity. The landlady aſſerts, that, late one evening, ſhe ſaw Mr. Jones drop one hundred drops of laudanum into a tea-cup, and add ſome wine, which he immediately carried into Mr. Iſaacſon's room. She followed him: he endeavoured to make Mr. Iſaacſon, who was ſo far delirious that he did not appear to know

Mr. Jones, ſwallow the contents: " on taſting " the medicine, he ſpit it out of his mouth; " cried out that it was laudanum, and that he " was poiſoned; but to the beſt of her obſer- " vation, he did not ſwallow any of the me- " dicine;" which ſoon after was thrown into the fire.

The interview, which the nurſe herſelf vows, that ſhe held with Dr. Brown at his houſe, may caſt ſome ſuſpicion on her integrity. But ſhe might, ſays Dr. Beddoes, have been thoughtleſs; or, though determined to reject his ſuit, ſhe might have been pleaſed with being ſolicited as arbitreſs between contending ſyſtems! The reſt of the evidence, he adds, is alſo conſiſtent with her teſtimony.

Dr. Duncan's indignation urged him to an immediate proſecution, which, as he was aſſured by ſome eminent advocates, would have terminated in the infliction of a ſevere puniſhment on the negociator. Dr. Monro diſcouraged this idea for reaſons which it would be injurious not to quote; they are thus aſſigned in the letter to Dr. Jones: " He was principally averſe to it on " your account, becauſe he conſidered you in " the light of an imprudent young man—he " imagined that the mal-practices might be ſuf- " ficiently proved of you, although they could " not be brought home to Dr. Brown, whom " he conſidered as the original aggreſſor. He

" was

" was averſe to it on account of Dr. Brown's " wife and infant children, who might have ſuf- " fered more ſeverely by it than we could eaſily " foreſee. And beſides this, he thought there " was but little danger that Dr. Brown ſhould " repeat ſuch practices, and ſtill leſs chance that " he would again find any ſtudent to be his aſſiſt- " ant in the manner that you had been." In theſe reaſons Dr. Duncan acquieſced *.

By this event his reputation was much injured. All chance of lucrative employment in his profeſſion deſtroyed. The cloud was completely burſt, and the unfortunate Dr. Brown involved in utter ruin. His receipts not being ſufficient to ſupport himſelf, a wife, and ſix children, he was thrown into priſon for debt, where his pupils followed him at an appointed hour to hear his doctrines.

We have before noticed, that gradually led, as it were, by the hand of nature, around the whole circle of ASTHENIC DISEASES, he became convinced that they all depended upon the ſame cauſe, which is *debility*; that they were all to be

* Vide Dr. Beddoes' life of Brown affixed to a new edition of his Elements The doctor upon this occaſion makes the following remark, which in my mind is too ſevere " By this intrigue all chance of lucrative employment in his profeſſion, *if he had any*, was deſtroyed. His character among his countrymen ſuffered *irretrievably*, nor have I *courage without better documents to undertake his vindication*."

removed

removed by the ſame kind of remedies, to wit, *ſtimulants*; and that neither their cauſe nor their cure differed but in degree. With reſpect to many STHENIC DISEASES, he had the honour of firſt explaining their origin; he was aware that neither the inflammation, nor the other ſymptoms attending them, as had been univerſally believed by ſyſtematics, were the cauſe, but the effect: that the inflammation aroſe from the cauſe, *i. e.* the diatheſis, or habit, and that it did not occur at all except in caſes where the diatheſis was very ſtrong. In fine, he experienced in his own perſon, that catarrh was not produced by cold, according to the common opinion, but by heat and other ſtimuli, and was removed by cold and other debilitating powers. By this diſcovery he was led to form a proper judgment of the catarrhal ſymptoms in the meaſles: concerning which the great man who ſo much improved the cure of ſthenic diſeaſes, but who never attained to any knowledge of the aſthenic, was miſled by the alexipharmic phyſicians. And, as theſe ſymptoms are the moſt dangerous part of the diſeaſe, he was right in ſuppoſing, that the proper treatment of them was of great importance to the cure of the whole diſeaſe. In conſequence it came out that the refrigerating antiphlogiſtic plan was of as much ſervice in the meaſles as in the ſmall-pox. In ſthenic diſeaſes he illuſtrated the

cauſe

caufe, enlarged the plan of cure, accounted for the fymptoms, and reduced the whole to a certain principle; he diftributed all general or univerfal difeafes into two forms, a fthenic and an afthenic. He demonftrated that the former depended upon excefs, the latter upon deficiency, of exciting power; that the former were to be removed by debilitating, the latter by ftimulant, remedies; that the noxious powers, which excited either, were the remedies of the other, and the contrary; and that they acted in the fame manner as the powers which produce the moft perfect health, with only a difference in degree *.

This clafs, as you might expect, was fmall, and his lectures never could have retrieved him, had not a nobleman in London, a ftranger to him, but not to his fame, hearing of his fituation, generoufly remitted money by Mr. Donaldfon, to pay his debts, and liberate him from his misfortunes. Seeing that he had now no profpect of maintaining himfelf by the practice of phyfic, or teaching his fyftem, at Edinburgh, he refolved upon the fcheme of quitting his country, and as he proceeded to London with his numerous family, he probably uttered the memorable words of Scipio:

> Ungrateful country, thou fhalt not even poffefs my bones.

* We fhall hereafter fully inveftigate the Brunonian doctrine in the courfe of this work refpecting difeafe.

Immediately

Immediately upon his arrival in London an accident befel him which I have heard Mr. Murray, the bookfeller in Fleet-ftreet, relate. The peculiarity of his appearance, as he moved along—a fhort fquare figure with an air of dignity, in a black fuit which heightened the fcarlet of his cheeks and nofe—fixed the attention of fome *gentlemen* in the ftreet. They addreffed him in the dialect of his country; his heart, heavy as it muft have been from the precarioufnefs of his fituation, and diftance from his accuftomed haunts, expanded at thefe agreeable founds. A converfation enfued, and the parties by common confent adjourned to a tavern. Here the ftranger was kindly welcomed to town; and after the glafs had circulated for a time, fomething was propofed by way of fober amufement—a game at cards, or whatever the doctor might prefer. The doctor had been too civilly treated to demur, but his purfe was fcantily furnifhed, and it was neceffary to quit his new friends in fearch of a fupply. Mr. Murray was the perfon to whom he had recourfe; the reader will not wonder that his interference fhould have fpoiled the adventure.

A London fharper of another denomination afterwards tried to make advantage by the doctor. This was an ingenious fpeculator in *public* medicines. He thought a compofition of the moft powerful ftimulants might have a run, under the title of Dr. Brown's *exciting pill*; and for the privilege

vilege of his name offered him a ſum in hand by no means contemptible, as well as a ſhare of the contingent profits. Poor Brown, needy as he was, ſpurned at the propoſal.

A few words will deſcribe the tenor of this unfortunate man's life after his removal from Scotland. Dr. Brown met with as violent an oppoſition in London as in Edinburgh. Public opinion can alone awe the body of eſtabliſhed phyſicians in any country into toleration of innovation; and knowledge on this ſubject was too little diffuſed for public opinion to operate with effect in his favour. He attempted to open a courſe of lectures at the Devil tavern, but with trifling ſucceſs. His new misfortunes confirmed a habit of intemperance. Dr. Cullen, who never mentioned Dr. Brown's abilities without praiſe, uſed often to ſay, that he had a temper very difficult to deal with. He now became more impetuous than ever; his lectures, of which I have one before me in manuſcript, is a torrent of invective, and he ſpeaks of the certainty of his ſyſtem becoming one day triumphant. But he did not live to ſee that day; he went to bed after lecturing apparently well, and the next morning was found dead in his bed, not without a ſuſpicion of his death being premature.

Oh! *Genius*, art thou to be envied or pitied? Doomed to form expectations the moſt ſanguine, and to meet with diſappointments the moſt mortifying!

tifying? To indulge towards others the moſt generous wiſhes, to receive thyſelf the moſt illiberal treatment? To be applauded, admired, and neglected? To be a friend to all, befriended, often, by none? Oh! Thou creative, diſcriminating power, ſource of inexpreſſible delights, and nurſe of unknown ſenſibilities, that perpetuate diſtreſs. Fancy ſhall embody *thy* form; and viſit the grave of Brown, to drop the tear of ſympathy, over that ingenious, unfriended, unfortunate phyſician.

It would be in the order of this ſection to trace the introduction and application of pneumatic medicine, but a knowledge of chemiſtry muſt be firſt acquired before this improvement can be properly underſtood. We therefore haſten to the Progreſs of Chemiſtry.

THE

PROGRESS

OF

CHEMISTRY.

Increſcunt quotannis Scientiæ, emendantur quotidie, et ad faſtigium ſuum optatum ſenſim ſenſimque, plurium virorum opera et ſtudio junctis, feliciter properant.

THUNBERG.

SECTION II.

CHEMISTRY is defined by Suidas to be the preparation of ſilver and gold. The word κατασκευὴ ſeems to imply no more than the ſeparation of ſilver and gold from their ores. Suidas adds, that the Emperor Dioclefian ordered all the books he could procure, which treated on theſe ſubjects, to be burnt; left the Egyptians ſhould by this art grow rich, and be tempted to rebel.

It ſhould, at firſt appearance, ſeem ſtrange, that a flat country, like that of Egypt, which was never remarkable for having either gold or ſilver mines, ſhould be celebrated for the ſkill of its

inhabitants, with reſpect to the treatment of metals. But, if we conſider the prodigious riches of ancient Egypt, we may, perhaps, find reaſon to ſuſpect, that it had, however, ſome other ſource of wealth than the fertility of the ſoil. It is not improbable, that the ancient Egyptians carried on a commerce into the inland parts of Africa, where gold ore, or gold duſt, was found, and perhaps ſilver; which traffic, for political reaſons, they might conceal from other nations. As the prieſts ingroſſed all the learning, as well as wealth, of the country, theſe were therefore the ſmelters and refiners of theſe ores; and the method of treating them they would probably keep to themſelves, both for national and private conſiderations. Hence, if they wrote upon the ſubject, whatever they delivered was ſo involved in allegory, and deſignedly obſcured, that nobody but their own order could find out the meaning. It is even probable, that they pretended to the art of converting baſer metals, which they uſed in their proceſſes, into real gold, the better to conceal the true ſources of their wealth. Now when men of learning, in after ages, met with their books, not being able to underſtand their true meaning, and not knowing how to decypher them, they might take their allegories in a literal ſenſe, and thus believe, that there really was a method of making gold from other metals. When ſuch a notion, fooliſh as it was, had once begun to prevail, it

Riſe of alchemy.

was

was natural enough for the avarice of mankind to leave nothing untried for the revival of ſo beneficial an art, ſuppoſed to be loſt. This miſtake was, probably, the foundation for all thoſe reſearches which have been made after the tranſmutation of metals; for I can never believe, that there ever was, in reality, any ſuch art; the converting of one metal into another being, in my apprehenſion, attended with as much difficulty as the converting a ſtone into a diamond. The miſtake was, however, very fortunate for chemiſtry; becauſe the experiments made on this account gave occaſion to the development of many important chemical diſcoveries.

The prieſts, in order to ſupport their reputation, wrote books on their pretended ſcience, and had the art of expreſſing the ſubject in a myſterious and learned jargon. Several of theſe obſcure writers ſeem ſenſible of the reproach, and they promiſe to ſpeak plain and intelligibly; but inſtead of revealing, they even expreſs their hidden ſecrets more obſcurely than any of their predeceſſors.

Afterwards chemiſtry was ſeized on as a ſource of wealth by princes, and it went from prieſts into the hands of common miners, and ſmelters of metals, men unacquainted with the liberal ſciences, debarred from all commerce with the learned world, condemned to lead their lives in darkneſs under ground, and to ſupport their wretched beings

with coarse and hard fare. Consider these men daily obnoxious to a thousand dangers, dreading what may happen, disturbed in mind, and leading a very uneasy life, trembling at the frequent earthquakes, the rapid torrents from the mountains, at the meteors and damps, the coruscations of the gross and sulphurous exhalations, the resoundings of the caverns, and the subterraneous bellowings. Under all this, having no wife or prudent person to consult, who might remove their vain fears, and restore light to their troubled minds: hence they gave their attention to superstitious tales, and fabulous stories, calculated to frighten as well as amuse, and, by increasing melancholy, from fools became madmen. Hence was seriously taught as part of chemistry the belief of sorceries, fascinations, inchantments, prognostics, the use of amulets, genii confined in seals, wands, rings, allegories, emblems, types, riddles; and a little truth was so blended with a large farrago of falsehood, that the real science of chemistry became invisible, and nearly obliterated.

The boasted pretensions of the early alchemists and chemists, could not escape the just censure of ROGER BACON, an Englishman, who, in the thirteenth century, like a bright star in a dark hemisphere, shone forth the glory of his country. This extraordinary person knew so well how to reduce the powers of nature within the rules of

Roger Bacon.

art,

art, as, by their combination, to perform things which far ſurpaſſed the pretended miracles of the magicians. He demonſtrated, by experiments, that human induſtry, with an inſight into nature, can produce effects, which they, with all their charms, ſorceries, and invocation of demons, are unable to imitate. He very eaſily, and with admirable ingenuity, expoſes the monſtrous and hurtful ſuperſtitions, deliriums, and enthuſiaſms of the times in which he lived. He very judiciouſly and religiouſly diſtinguiſhes between the ſacred myſteries of piety, and the ridiculous chimæras and inventions of an unſettled brain; between the corruptible principles of the body, and the celeſtial origin of the ſoul; between nature and God. He points out with equal ſagacity and truth, the folly of the blind ſuperſtition of his contemporaries. "Admiration, ſays he, the parent of "magic, is the offspring of ignorance, begot "by a vitiated imagination. When weak and "ignorant minds perceive an effect, whoſe cauſe "is hid far in the dark, they preſently have re-"courſe to ſomething ſupernatural to ſolve the "difficulty, and fancy it the production of ſome "magical power." He adds, "there is no ſuch "thing really as magic, unleſs by that word be "meant a knowledge of the properties of bodies, "and the methods of nature, by an obſervance "and application of which many things, even much "more ſurpriſing than magic, can be effected."

Neverthelefs Francis Bacon was accufed and found guilty of having dealings with the devil, was excommunicated by the pope, and for ten years kept in clofe confinement.

By an attentive perufal of his works, the reader will be aftonifhed to find, that this great luminary, at fo diftant a period as the thirteenth century, underftood not only chemiftry, and really was the inventor of gunpowder * and phofphorus, but that he alfo was acquainted with the ufe and art of making convex and concave glaffes, the camera obfcura, burning glaffes, telefcopes, and contrived fomething like an air pump; and he mentions himfelf, "that in the fpace of twenty "years ftudy of nature, in the purchafe of inftru-"ments, and fcarce books, he fpent upwards of "two thoufand pounds;" a vaft fum in thofe days. His writings are equally elegant and nervous.

We will not tire the reader with tracing the progrefs of chemiftry through the dark and fabulous ages of chemiftry: but commence at that time when alchemifts gave up their golden dreams, and turned their attention to improve by this art the fcience of medicine.

* Speaking of this difcovery, Friar Bacon fays, if you mix fulphur and nitre with a third fubftance, which I will not name from the dangerous ufes it may be put to, an explofive powder may be formed, &c.

BASIL VALENTINE ſeems to have been the firſt who employed *antimony*. He was a Benedictine monk, and flouriſhed about the fifteenth century. It is reported of him, that having thrown away ſome antimony, he noticed the ſwine, who accidentally had eaten it, purged greatly, and, to his no great aſtoniſhment, afterwards grew extremely fat. He began immediately to employ it as a medicine, and ſhortly after publiſhed his Currus Triumphalis Antimonii (the Triumphal Car of Antimony), where he highly extols the virtues of this mineral, and its preparations, for the cure of an infinite number of diſeaſes. This remedy, however, was looked upon, even in his time, as an highly pernicious poiſon, and Jacob Grevinus publiſhed a treatiſe againſt it, in which he adviſes the magiſtrates to prohibit its ſale, as they had done that of quickſilver and orpiment. *Baſil Valentine.*

The doctrines of Galen, which were ſpread over Europe, had taken ſuch firm root in the 16th century, that they ſeemed to defy all oppoſition. The remedies invented by chemical operations were at that time only adminiſtered by men in the loweſt condition of life, men without ſcience, without induſtry, and without honour At length, however, PARACELSUS appeared. He does not ſeem to have ſtudied phyſic in any of the eſtabliſhed ſchools; but while he travelled in different countries he picked up remedies from all ſorts of peo- *Paracelſus.*

ple, and particularly from the chemifts of thofe days. From thefe he learned the ufe of mercury and antimony, and from fome hardy empirics the ufe of opium. When returning home from his travels he determined upon following his father's profeffion, which was that of phyfic, and by thefe remedies he was able to cure many difeafes that baffled the inert remedies of the Galenifts; and being of a bold and boaftful difpofition, he made the moft of thefe cures; while, at the fame time, the partiality of mankind to novelty foon contributed to give him fame. He was fo far more fortunate than other chemical practitioners that he obtained the profeffor's chair at the univerfity of Bafil. In this new fituation he attempted a fyftem of phyfic, blended with the moft extravagant and vifionary doctrines, fupported and covered by a great deal of new and unmeaning jargon of his own. His lectures were chiefly employed in recommending his own chemical remedies, and declaiming in the moft outrageous manner againft the regular practitioners. He went even fo far as publicly to burn the works of the Greek phyficians; and he infolently told the phyficians of Bafil, that the very down of his bald pate had more knowledge than all their writers, the buckles of his fhoes more learning than Galen or Avicenna, and his beard more fenfe than all the univerfities together.

He not only taught the pretended and imaginary

ginary agreement betwixt the principal parts of man's body with the planets; as of the heart with the Sun, of the brain with the Moon, of the ſpleen with Saturn, of the lungs with Mercury, the kidneys with Venus, the liver with Jupiter, and the gall with Mars; and the agreement of the ſeven metals to diſorders of theſe parts as they agree with the ſeven planets, the power of vigils, incantations, &c. but alſo added to theſe abſurdities animal magnetiſm, uſing the hand, a doctrine which has made ſo much noiſe in our own time *. He alſo had a panacea againſt all diſorders,

* The introduction of this ſcheme in France was undoubtedly with a view to throw ridicule on the *Chriſtian religion*. The profeſſors of this art pretended impiouſly, that by faith they could obtain of God power to work miracles as our Saviour did. In the lectures of D'Menaduc, publiſhed after his demiſe, he ſays, that by faith he has broken the ſtone in the bladder into pieces, and to aſſiſt his faith, his hands muſt work at the part, repreſenting the action of breaking; a tooth in this way can be extracted, and at any diſtance, &c. He calls GOD to witneſs his ſincere conviction of his poſſeſſing this power, through Jeſus Chriſt; yet he was univerſally known to be a deiſt. Opinus quitted Paracelſus from an impious jeſt on our Saviour, and he was obliged to leave his country for ſpeaking words tending to ſedition. I am inclined to think, that ſome of the learned of days of yore wiſhed to overturn the ſyſtems of government then eſtabliſhed, and wrote many books, darkly introducing their ſubverſive plans; and whatever is affirmed of metals, chiefly relates to the refining of man, which is the true key to interpret their myſterious ſayings. Barruel

 aſſerts

orders, and boaſted that he poſſeſſed drugs that could prolong life to any period.

It ſeldom happens that a man of but common abilities, and in the moſt retired ſcenes of life, obſerves ſuch a ſtrict uniformity of conduct, as not to afford prejudice and partiality ſufficient materials for drawing his character in different colours; but ſuch a great and irregular genius as Paracelſus could not fail of becoming alike the ſubject of extremes of panegyric and of ſatire. He has accordingly been eſteemed by ſome a ſecond Æſculapius; and others have thought that he was poſſeſſed of more impudence than merit, and that his being ſpoken of, was more owing to the brutal ſingularity of his conduct, than to the cures he performed.

But in whatever eſtimation the merit of Paracelſus as a chemiſt or phyſician be held, certain it is that he formed a ſect of practitioners, who appeared in oppoſition to the eſtabliſhed ſchools, which were then entirely followers of Galen, and theſe two adverſe parties agitated Europe for more than five hundred years.

aſſerts that the Encyclopedia of the French was eſtabliſhed for this purpoſe. So artfully was it contrived, that whenever the ſubject of religion was treated, the end always referred to the words prejudice, or ſuperſtition, and under the maſk of refuting dangerous errors, the readers, feeling the weakneſs of the arguments uſed, were ſilently brought over to the other ſide. Gibbon employs the ſame dangerous weapon in his Roman Hiſtory; and Hume does the ſame in his Eſſay.

VAN

VAN HELMONT flouriſhed about ninety years after Paracelſus. He was born of a noble family at Bruſſels, and medicine in thoſe days being a profeſſion beneath his rank in life, he gave up his paternal inheritance to his family, and left his country in order to purſue the bent of his genius. Having conceived a violent prejudice againſt the *Galenical methods* from his own ill ſucceſs in putting them into practice, and finding *chemiſtry* productive of ſo many, and ſuch powerful medicines, he ran counter in every thing to the *Galenic doctrines*, and endeavoured to reduce the whole practice of phyſic to the principles of chemiſtry. In the year 1609 he married a very rich lady, after which he gave himſelf up wholly to chemiſtry; and although he did not viſit any one out, ſo great was his reputation, and not practiſing for gain, that he cured, as he aſſures us, every year, ſome thouſands of ſick people. He employed fifty years of his life in aſſiduouſly examining the foſſil, animal, and vegetable kingdoms. VanHelm

His ſkill was ſo great, and the phænomena his chemiſtry preſented ſo marvellous, that he was accounted a magician, and thrown into the inquiſition: and having with difficulty extricated himſelf from this abominable charge, he was releaſed, and retired to Holland.

He firſt gave the name of *gas* to thoſe vapours, which reſemble the air we breathe. He obſerved,

" that

" that some bodies resolve themselves almost entirely into this aeriform substance. Not," adds he, " that they are contained in this shape in " those bodies from which they are separated; " but exist in them in a concrete form, as if fixed " or coagulated. He asserts, that 62 pounds of " charcoal contain 61 pounds of gas, and only " one pound of earth." The gas which flies off from calcareous earths and metallic bodies, while they effervesce in acids, did not escape his notice: " the quantity contained in tartar is so " great, that it breaks and bursts into shivers " the vessels in which it is distilled, if a free " egress be not given to it." He applied this theory to the explanation of some phænomena of the animal œconomy. It is to this effluvium that Van Helmont attributes the fatal effects of the Grotto Del Cani;—the suffocation of workmen in mines;—the accidents occasioned by the vapour of charcoal;—and that deleterious atmosphere which is breathed in cellars, where spirituous liquors are in fermentation. He accounts for several diseases upon this principle, and ascribes the propagation of epidemical disorders to noxious vapours with which the air is sometimes infected.

Van Helmont undoubtedly would have made a still greater figure in the world had he forborne running into the notions of Paracelsus, and given less into the superstitions of the times. His reputation

putation has alſo ſuffered from his poſthumous works. As he perceived his end approaching, he called for his ſon, and gave him the following charge. "Take all my writings, the crude as "as well as finiſhed ones, and join them toge-"ther, and publiſh them; for ſo it hath pleaſed "God Almighty, who directs all things for the "beſt." And the ſon, who in his early youth had ran away from his father to ſtroll with gipſies, after the father's deceaſe, literally jumbled all the papers together, which had been framing for fifty years, and then left the impreſſion wholly to the printer without the ſmalleſt correction.

Nothing but ſucceſs could ſhake off the torpor or vanquiſh the bigotry of the Galeniſts. Theſe at laſt finding their throne totter, called in the aid of the ſecular power, and employed it to cruſh their adverſaries. In France antimony was prohibited: but in Germany the chemiſts prevailed, and the Galeniſts were obliged ſometimes to have recourſe to the remedies of the chemiſts, when SENNERTUS, one of the moſt eminent of the Galeniſts in Germany, endeavoured to reconcile the two oppoſing parties. *Sennertus.*

Very early in the ſeventeenth century, Sir THEODORE MAYERNE, who as a chemical phyſician had been much oppoſed and oppreſſed by the Galeniſts of France, was called over into England, where he was appointed firſt phyſician to the king, and continued to hold that office for *Sir Theodore Mayerne.*

 more

more than thirty years after. His theory and his prescriptions were like those of the Galenists; but he was at the same time a great favourer of chemical medicines, and particularly of antimony; the medicine, with regard to which the two sects were most especially divided. It does not however appear, that he met with any violent opposition from the physicians in England: but, on the contrary, we find him becoming a member of, and acquiring great authority in, the London college. It is probable that his great credit put an end in England to all distinction between the Galenic and chemical practitioners; and, as in the year 1666, the faculty of Paris rescinded their arret forbidding the use of antimony, the odious distinction between the Galenists and chemists gradually diminished.

I shall not presume to decide which of the two great branches of natural philosophy contributes most to the use and the ornament of life; but I think it natural that the mechanical department, where palpable masses of matter are brought into action, and motion is visible in its progress, should sooner advance towards perfection than the chemical, where effects are produced by the insensible movements of imperceptible particles. It seems therefore to have its foundation in the order of things, says Dr. Beddoes, that the philosophers of the preceding age should have been employed chiefly by astronomers and mechanics,

and

and thofe of the prefent by *chemiftry*. Yet if the rule be at all juft, what a violent exception,—fuffer me to repeat it,—have we in the inftance of our own countryman Dr. HOOK, who filently, and unperceived, difcovered, if not the whole fum and fubftance, yet certainly many of thofe fplendid facts which adorn the writings of Prieftley, Cavendifh, Scheele, Lavoifier, and other philofophers of the prefent day. *Hook.*

" From the experiment of charring of wood" (which is done by putting it into a crucible, pot, or any other veffel that will endure to be made red-hot in the fire without breaking, and then covering it over with fand, fo as to prevent the accefs of air, and continuing it in a ftrong heat for an hour or more, according to the fize of the body to be charred), " feeing " that, notwithftanding the great heat, and the " duration of it, the folid parts of the wood re- " main undiffipated whilft they are preferved " from the free accefs of air, we may learn," fays he, " *what has not, that I know of, been* " *publifhed or printed, nay, not fo much as thought* " *of by any*; and that, in fhort, is this:

1ft. " That the *air* in which we live, move, " and breathe, that this air is the menftruum, " or univerfal diffolvent of all inflammable " bodies.

2d. " That this action it performs not until " the body be firft fufficiently heated.

3d. " That this action of diſſolution pro-
" duces or generates a very great *heat*, or what
" we call fire.

4th. " That from this action *light* is alſo
" produced.

5th. " That theſe phænomena do not ariſe
" from the air itſelf conſidered as an element,
" but from *that part* of the air which is inherent
" in it, and is *like*, if not the *very ſame*, as *that*
" which is *fixed* in *ſalt-petre*, which may, I think,
" moſt evidently be demonſtrated by a multitude
" of experiments made by ſalt-petre.

6th. " That by this diſſolution the inflamma-
" ble body mixing with the nitro-aerial part of
" the air, becomes a new kind of air, juſt as metal-
" line or other bodies, diſſolved in any men-
" ſtruum, does the motions and progreſs of that
" menſtruum, until it be precipitated.

" This *theory* of mine," he continues, " does
" ſo exactly agree with all the phænomena of
" fire, and ſo genuinely explicates each particu-
" lar circumſtance, as the production of *heat*
" and *light*, and the *diſappearance* of the *burn-*
" *ing body*, that it is more than probable that
" this cauſe which I have aſſigned is the true,
" adequate, real, and only cauſe of thoſe phæ-
" nomena. As the idea is *entirely new*, I will
" proceed a little further.

7th. " The diſſolving part of the air is but a
" ſmall part of the whole air, and reſembles
thoſe

" those acid menstruum containing other parts
" besides the acidifying principle, therefore they
" are soon glutted and can dissolve no more:
" and therefore unless some fresh part of the
" menstruum be applied to the body to be dis-
" solved, the action ceases, and the body ceases
" to be dissolved; saltpetre, on the other hand,
" being replete with these dissolving particles,
" hence the dissolution of inflammable bodies
" will be very quick and violent, therefore it is
" observable, that, as in other solutions, if a co-
" pious and quick supply of fresh menstruum,
" though but weak, be poured on, or applied to
" the dissoluble body, it quickly consumes it;
" so this menstruum of air, if by bellows, or
" any other such contrivance, it be copiously ap-
" plied to the shining body, is found to dis-
" solve it as soon as the menstruum of burning
" nitre."

" This theory of *mine*," he again repeats it,
" of the action of air, and of that particular
" part, which I would call nitro-aerial, I have en-
" deavoured to raise from an infinite number of
" observations and experiments, the process of
" which would be too long to be here inserted,
" (he means in his micrographia published in
" 1664), and will perhaps another time afford
" matter copious enough for a much larger dis-
" course, the air being a subject which, (though
" all the world has hitherto lived and breathed

 " in,

"in, and has yet been so little truly examined
"or explained, that a diligent enquirer will be
"able to find but very little information from
"what has been written of it: but being once
"well understood, it will, I doubt not, enable a
"man to render an intelligible, nay probable,
"if not the true reason of all the phænomena of
"fire, which, as it has been found by writers
"and philosophers of all ages, is a matter of no
"small difficulty, as may be sufficiently under-
"stood by their strange hypotheses, and unintel-
"ligible solutions of some few phænomena of
"it, so will it prove a matter of no small con-
"cern and use in human affairs, as I shall else-
"where endeavour to manifest when I come to
"shew the use of air in respiration, and for the
"preservation of the life, nay for the conserva-
"tion and restauration of health, as also its uses
"in chemical, mechanical, and other operations.
"In this place it becomes me only to hint an
"hypothesis, which, if God permit me life and
"opportunity, I may elsewhere prosecute, im-
"prove, and publish."

Hook, here, reasons perfectly correct, and we see him afterwards laying open the thorax of a dog, cutting away his ribs and diaphragm, and taking off the pericardium, and in that state keeping him alive before the Royal Society, he blowing fresh air into his lungs. "It was observed," he remarks, "that as often as we left of blowing,

"and

"and ſuffered the lungs to ſubſide and lie ſtill, "the heart ceaſed to beat, the animal became "convulſed, but he ſoon recovered again by re- "newing the blaſt."

To prove that the motion of the lungs in breathing was no otherwiſe neceſſary to the life of the animal, than as by this motion the lungs receive a conſtant ſupply of freſh air, he next pricked all the outer coat of the lungs with the ſlender point of a ſharp penknife, and by a conſtant blaſt made by a double pair of bellows, he kept the lungs always diſtended, ſupplying the air as faſt as it eſcaped by theſe apertures, and it was obſerved that while the blaſt from the bellows was kept up, the blood flowing from the pricks in the ſubſtance of the lungs was of a bright florid colour, that the dog lay ſtill, his eyes were quick, and his heart beat regularly; but that upon leaving off blowing, the blood iſſuing from the punctures in the lungs was of a dark colour like venal blood, the heart ceaſed to act, the eyes appeared ſunk, and the dog fell into convulſive motion, and he as ſoon recovered again on renewing the blaſt, and ſupplying the lungs with air. It would be foreign to this work to enter more fully into the diſcoveries of Hook. I can only here expreſs my aſtoniſhment, that doctrines like his, confirmed by actual experience, and afterwards improved by Mayow, ſhould be ſo long loſt to the world, and that Dr.

 Hunter

Hunter, a lecturer of great learning, ſhould ſay, not twelve years ago, that the office of the lungs is unknown to us at the preſent day, and if we are ever fortunate enough to find this out, we ſhall as ſurely perceive that this organ is deſigned from ſome very important function, as we know the heart, and the other organs poſſeſs very important offices. Till of late the whole of chemiſtry was a mere jargon throughout, and it is curious, that what is called modern improvement ſhould be only the bringing us back to the old beaten path. You ſee alſo, what accidents give riſe to great things. An apple toſſed in the air by a child made Sir Iſaac Newton reflect on the reaſon of its falling, and he made projection and gravity the two principles that unlocked the whole myſtery of the motions of the heavenly bodies. So the contemplation of a piece of burnt wood, diſcloſed the vegetable anatomy, and the true ſyſtem of chemiſtry, and the only rational phyſiology, which now that phyſicians have turned their attention to it, one day or other promiſes to be the greateſt bleſſing to the human race.

As I am about to draw the firſt line of the next ſketch, my hand is ſuſpended by the intruſion of a wiſh, that has often before mixed with my thoughts. It may, perhaps, be not a very inviting taſk, but methinks in the ſuperfluity of literary men, one at leaſt might be ſpared from

other

JOHN MAYOW, M.D.

er ſervices, to explore the dark volumes of ent chemiſtry. Should any one, however, e able, ſo far to ſubdue his diſguſt, as to define, by careful inquiry, what degree of knowledge has been acquired from ſyntheſis and analyſis concerning the conſtitution of bodies before the middle of the laſt century, I am ready to believe, that he would find more credit due to MAYOW, ſays Dr. Beddoes, than I dare venture at preſent to aſcribe to him. "* *He was acquainted* "*with the compoſition of the atmoſphere,—and per-* "*ceived the action of VITAL AIR in almoſt all* "*the wide extent of its influence. He was well* "*aware of the cauſe of the increaſe of weight in* "*metallic cakes; and diſtinctly aſſerted, that cer-* "*tain baſes are rendered acid by the acceſſion of the* "*vital air, or what has been ſince called oxygen,*

* Vide Dr. Beddoes's Analyſis of Dr. Mayow's work, or Dr. Yeats's Examination of the Claims of the Moderns, neither of whom even ſo much as ſuſpected the priority of HOOK, who appears to me (if the diſcovery was made) to have firſt produced *vital* or *oxygen air* from nitre. Mayow in oppoſition to this, has a chapter purpoſely to ſhew that there was no *air* contained in nitre, and has alſo ſeveral other alluſions againſt this ſuppoſition. Vide note page 289, where Mayow's doctrines are conciſely exhibited. The ſentiments of Hook, who publiſhed four years before Mayow, are more fully explained in our PHILOSOPHY OF BOTANY, or BOTANICAL EXTRACTS, INCLUDING A NEW ILLUSTRATION OF THE SEXUAL SYSTEM OF LINNÆUS, to which we refer the reader. It is publiſhed at preſent in Numbers, at a Guinea per Number, by Symonds, Paternoſter-row.

"*or the acidifying principle. His doctrine of respi-*
"*ration is equally just. He has carried on his in-*
"*vestigation of this function from the diminution of*
"*the air by the breathing of animals, to the change*
"*it produces in the blood during its passage through*
"*the lungs. The office of the lungs,*" says he,
"*is to separate from the air, and convey to the*
"*blood one of its constituent parts.*" At the age of twenty-six he formed the peculiar system, continues Dr. Beddoes, which pervades all his works. The Dutch translator of his writings (an honour which they did not obtain from any other people), in the preface to them, affirms, *that his philosophy found very little approbation in his own age.* So much does the fortune both of truth itself, and of those who speak it, depend upon the disposition of the times in which it is spoken. None indeed smiled upon the fair features of this new-born offspring of science. His name, therefore, as it never was echoed by popular applause, was soon forgotten among men, and his memory obliterated. In the *Biographia Britannica* there is no article appropriated to him. But henceforth, I hope, that when the enthusiasm of an Englishman salutes his country, as

Magna parens frugum!
Magna virûm!

Mayow

Mayow will be ranked in the list of her *illustrious men.*

Boyle was contemporary with Hook and Mayow; he was in opulent circumstances, and by the agreeableness of his manners, and goodness of his heart, he was peculiarly turned to the study of nature, which pleased him most, and the knowledge of which he cultivated in the way recommended by Lord Bacon *. He was possessed of that penetration and ingenuity of mind, which in experimental philosophy serves to point out the shortest, simplest, and most useful, experiments, and which enabled him to deduce the *Boyle*

* The illustrious Bacon formed plans for promoting the sciences in general, and particularly the study of nature. In his comprehensive view of things, he felt that chemistry might turn out one of the most curious and useful branches of natural philosophy. He advised the collecting of facts, and to compare these very maturely and cautiously, in order to discover, if possible, the causes and circumstances upon which they depend, and declares that in this way only could any satisfactory system be produced. *Theories*, he thought, were only useful so far as they arose from *experiments* already made, or as they might lead to new ones: for *reasoning* may be considered as the eye of the philosopher, but *experience* is his feeling; and this latter sense ought constantly to rectify the too frequent errors of the former. "If *experiments*, undirected by theory, are "only a blind feeling; *theory*, without experiments, is a de- "ceitful and uncertain vision. —It was thus that this sagacious philosopher directed men in the true path of science, and banished for ever that dark and abstruse philosophy, which was built upon the absurdest conjectures.

most important truths from the most simple and insignificant facts. These are the talents we distinguish in an eminent degree in this philosopher, and for which Sir Isaac Newton was afterwards so remarkable. He examined the prevailing philosophy of the chemists, and exposes its weakness; but he does it with a temper, candour, and modesty, which is truly admirable. What Van Helmont called *gas*, Boyle denominated *artificial air*. Furnished with the new instruments with which he has enriched natural philosophy, he repeated all Van Helmont's experiments in vacuo, in condensed air, and in the open air. He made numerous discoveries in this branch of science, and did not fail to notice that there are bodies such as sulphur, camphor, &c. "which *diminish* the volume of air in which they "burn."

The experiments of Van Helmont, of Boyle, and of Mayow, had made it evident that a great quantity of elastic fluid analogous to air was separated from bodies in many operations;—and that also in some other operations a portion of atmospheric air was absorbed; but no one had any idea of the *exact quantities* either produced or absorbed.

Dr. Hales Dr. HALES was the first person who accomplished this useful purpose. Hence it did not escape this benevolent and indefatigable philosopher, that the quantity of air *absorbed* either by the

the burning of ſulphur or of candles, or by the reſpiration of animals preſented different appearances, according to the quantity of air employed. He diſcovered that this abſorption of air is limited, and that it never proceeded beyond a certain point.

Dr. Hales, in the courſe of his experiments, has obſerved alſo the alternate *production* and *abſorption* of air, of which he, however, does not ſeem to have underſtood the true cauſe: the burning of charcoal, and other ſubſtances, furniſhed him with a great *increaſe* of air, but that air *diminiſhed* daily. This phænomenon depended upon the water which the Doctor uſed in theſe experiments: and it will be ſhewn hereafter, that moſt of theſe vapours, and particularly thoſe which we are accuſtomed to denominate *fixed air*, have a great affinity for water, which is capable of abſorbing more than its own bulk of *this air*.

The great number of experiments made by Doctor Hales, which may be found in chap. vi. of his *Vegetable Statics*, comprehends vegetable, animal, and mineral ſubſtances. He has examined into the effects of fermentation, chemical diſſolutions and combinations, the combuſtion of bodies, and reſpiration. Too much cannot be ſaid to induce the reader to peruſe his ineſtimable work. He will find in it a moſt inexhauſtible fund of meditation.

It is in this work, that we perceive the firſt

traces

traces of the exiſtence of air in thoſe waters, which are called *acidulous.* Dr. Hales has not only remarked that theſe waters contain four or five times more air than common water, but he alſo ſuſpected that they owed their remarkable ſparkling and briſkneſs to this air.

All the philoſophers of his time believed, that fire became fixed, and combined itſelf with metals, and that to this addition they owed their reduction to a ſtate of calx. Dr. Hales has not only diſcarded this error, but he has moreover advanced that air contributed to produce that effect, and that to it alone muſt be attributed the augmentation in the weight of metallic calces. He grounded his opinion chiefly in having obtained from 1922 grains of lead, only 7 cubic inches of air;—whereas an equal quantity of minium afforded him 34 cubic inches *.

Dr. Hales, in ſumming up his knowledge on this ſubject, compares the air to " a true Proteus, " now fixed, now volatile, entering into the com- " poſition of bodies, where it exiſts in a ſolid " form, deprived of elaſticity, and of thoſe pro- " perties which formerly diſtinguiſhed it, adding

* Theſe muſt have been *oxygen air*. But, I believe, neither Hook, Mayow, or Hales, knew this pure air, however ingeniously they might have reaſoned about the nitro aerial particles as a conſtituent part of the atmoſphere, and although each had obtained it diſtinct, as their ſeveral works ſufficiently demonſtrate.

" gravity

"gravity to these bodies, and under certain cir-
"cumstances alone capable of recovering its elas-
"ticity, and becoming again an elastic and thin
"fluid, and therefore deserving to be adopted
"among chemical principles, and to possess a
"rank which has hitherto been denied it."

The immortal BOERHAAVE, the honour of his country, of his profession, and of his age, next improved upon the experiments of Dr. Hales, by not permitting the factitious airs to have any communication with *water*. "It must be ac-"knowledged," says he, "that by chemistry we "separate from bodies an *elastic vapour*, and con-"sequently that this aerial matter resides in them, "but in such a manner as not to have the pro-"perties of air, as long as it is combined and "united;—but that whenever it is detached, it "resumes its former nature, and becomes *true* "*air*, disposed to reunite with other substances "again, and remain quiet, but without losing its "real nature; for whenever it is freed from the "bonds which retain it, it shews itself to be the "same body. Nothing can be more certain than "this *resolution* and *composition*; and I would have "given," says he, "many examples of it, had I "not lately read Dr. Hales's celebrated treatise "on Vegetable Statics; in the sixth chapter of "which book, the author has collected with so "much labour and justness, and has related in "the best possible order, the experiments which "have

"have been made on this ſubject, ſo that he has
"exhauſted the ſubject. To theſe I refer my
"readers, and they will ſee how ART has arrived
"at the power of *unveiling* NATURE."

Hitherto chemiſtry, though it was much advanced, had been treated only in a deſultory manner. A great number of facts were diſcovered; but none had attempted to generalize them, and form a ſyſtem; and though many particulars were known, yet the ſcience itſelf was not in exiſtence.

Becher. The illuſtrious BECHER firſt began to collate, examine, and compare, the immenſe ſtore of chemical facts, and obſerve their relations. This man, whoſe genius equalled his knowledge, ſaw, with a ſingle glance, the immenſe multitude of chemical phænomena. He invented a *theory* that ſoon obtained credit all over Europe. He was invited to Vienna, where he contributed to the eſtabliſhment of ſeveral manufactures, a chamber of commerce, and an India company, but the jealouſy of the miniſtry finally accompliſhed both his diſgrace and ruin. He was not leſs unfortunate at Mentz, Munich, and Wurtzburg; which determined him to go to Haerlem, where he invented a machine for working a great quantity of ſilk in a little time and with few hands; but new diſgraces and misfortunes made him retire to England, and he died in London in 1682, at the age of 57, of a broken heart.

The

The theory invented by Becher was adopted and commented upon by STAHL, principal physician to the king of Prussia. Born, as Becher was, with a strong passion for chemistry, which shewed itself in its early youth, he inherited a genius equal to that of Becher. His imagination was as lively, as brilliant, and as active, as that of his predecessor, and he had the advantage of being heard with attention. In the opinion of these two philosophers *fire* enters into the composition of all inflammable bodies, and into metals and most minerals, and in that condensed, compacted, fixed state, it was called PHLOGISTON * (latent fire), to distinguish it from its condition when in a free state. *Stahl.*

We behold flame, we see bodies consumed, we feel a pleasing, and sometimes a painful sensation, when we approach within the sphere of these phænomena. Now is this fire as much a material body, as a piece of wood, or glass, or stone, or any other substance? If it be, whence does it arise? and what becomes of it?—We neither saw or felt it before the body was kindled; and when the fuel is consumed, it no longer appears.—In answer to these questions Becher and Stahl tells us, "that *fire*, or PHLOGISTON, is actually "a material body, and liable to be modified by *The Doctrine of Phlogiston*

* A word derived from the Greek word φλωξ, γος, flame, or fire.

"the

" the influence of circumſtances. In bodies liable
" to burn, it exiſts in a latent ſtate:—place them
" in circumſtances in which combuſtion is pro-
" duced—you then will behold it, perceive it
" operate, and feel its influence.—In bodies, as
" metals, though you do not perceive the
" flame, yet will you diſcover this principle by
" the alteration of their properties. Hence it
" is,

The combuſtion of ſulphur.

" If you take a piece of SULPHUR, and ſet it
" on fire, it will burn entirely away, without leav-
" ing any aſhes, or yielding any ſoot. During
" the burning of the ſulphur, a copious vapour,
" powerfully affecting the organs of ſight and
" ſmell, and the action of the lungs, is diſperſed.
" Means have been invented for collecting this
" vapour, and it is found to be a very ſtrong acid.
" The acid thus procured from the burning of
" the ſulphur, is incapable of being either burnt
" by itſelf, or of contributing towards the ſupport
" of fire in other bodies; the ſulphur from which
" it was procured was capable of both: there is a
" remarkable difference then, between the acid
" procured from the ſulphur, and the ſulphur it-
" ſelf. The acid is not the only conſtituent part
" of the ſulphur:—is it not evident then that it
" muſt have contained *ſomething* elſe, by which it
" was rendered capable of combuſtion? This
"*ſomething* is, from its remarkable property of
" rendering a body combuſtible, denominated
" therefore

" therefore PHLOGISTON, or the *inflammable*
" *principle*."

Of charcoal.

" If you burn CHARCOAL in the open air, and
" hold a glaſs over its flame, you will perceive
" that it burns without emitting either any wa-
" tery vapour or ſooty impurity; and nothing
" will remain, from a large portion of charcoal,
" but a ſmall quantity of white aſhes, which are
" incapable of any further combuſtion. The
" principle effecting the combuſtion of the char-
" coal, and diſperſed by the act of combuſtion, is
" the PHLOGISTON.

Of ſpirits of wine.

" If you ſet SPIRITS OF WINE on fire, they
" will, if pure, burn entirely away; they differ
" from charcoal in this, that they emit a vapour:
" but they leave no reſiduum. You may, by
" proper veſſels, collect the vapour of burning
" ſpirits, and you will find it to be an inſipid
" water, incapable of combuſtion. The princi-
" ple effecting the combuſtion of the ſpirits of
" wine, and diſperſed by the act of combuſtion,
" is the PHLOGISTON.

Of metallic bodies.

" Some METALLIC SUBSTANCES burn, when
" ſufficiently heated, with a flame more bright
" than that of ſpirits of wine or charcoal: others
" burn or ſmother away like rotten wood; and
" moſt of them, when they have been kept in
" the open air in a proper degree of heat, loſe
" their metallic appearance, and are converted
" into earth. Thus red lead or minium is the

" earth

" earth procured from the burning of lead; and " putty, such as the polishers of glass and marble " use, is the earth procured from tin. The prin- " ciple effecting the combustion of metallic sub " stances, and dispersed in the act of combustion, " is PHLOGISTON.

Products of combustion.

" The *acid* of *sulphur*;—the *ashes* of *charcoal*; " —the *water* of the *spirit* of *wine*,—the *earths* " of *metallic substances*, are utterly incapable of " combustion: their respective differences from " SULPHUR, CHARCOAL, SPIRITS OF WINE, and " METALLIC SUBSTANCES, with respect not only " to *inflammability*, but to *smell*, *colour*, and *other* " *properties*, are attributed to the PHLOGIS- " TON which is dispersed during the combus- " tion of each of them."

" From the ANALYSIS or decomposition of " SULPHUR, we conclude that the constituent " parts of sulphur are two—an *acid* which may " be collected; and an INFLAMMABLE " PRINCIPLE which is dispersed. The reader " will wish to see this ANALYSIS confirmed by " synthesis, that is, in common language, he will " wish to see sulphur actually made by combin- " ing its *acid* with the *inflammable principle*."

Sulphur obtained from vitriolic acid by means of charcoal

" As this *inflammable principle* cannot be ob- " tained in a palpable form separate from all " other bodies, the only method by which we " can attempt to unite it with the acid of sulphur, " must be by presenting to that acid some sub-

" stance

" ſtance in which it is contained.—Charcoal is " ſuch a ſubſtance, and by diſtilling powdered " charcoal and the acid of ſulphur together, we " can produce undoubted ſulphur. This ſulphur " is formed from the union of the acid with the " PHLOGISTON; and the charcoal may be " by this means ſo entirely robbed of its PHLO- " GISTON, that it be reduced to the ſtate it is " found after complete combuſtion in the open " air."

" Spirits of wine, we have ſaid, conſiſts of " PHLOGISTON united with *water*:—and if " we diſtil ſpirits of wine and the acid of ſulphur " mixed together we ſhall obtain a pure yellow " ſulphur, in no way to be diſtinguiſhed from " common ſulphur.

" But one of the ſhorteſt and moſt obvious " ways of illuſtrating both the compoſition of " ſulphur and PHLOGISTON of metallic ſub- " ſtances is the following.—Upon melted lead " pour the acid of ſulphur, collect the vapour " which will ariſe, by holding a very large glaſs " or other veſſel over the melted lead, and you " will, as ſoon as the vapour is condenſed, ob- " ſerve ſeveral filaments of ſulphur ſticking to " the ſides of the glaſs. Here, when the lead is " in a ſtate of ſtrong fuſion, its PHLOGISTON " is in a ſtate of diſperſion; and the acid of ſul- " phur inſtantaneouſly unites itſelf with this *phlo- " giſton*, and forms ſulphur.

" I will in this place, by way of further illuſ-" tration of the doctrine of PHLOGISTON, " add a word or two concerning the neceſſity of " its union with a metallic earth, in order to con- " ſtitute a metal.

" Lead, it has been obſerved, when melted in " a ſtrong fire, burns away like rotten wood; all " its properties as a metal are deſtroyed, and it " is reduced to aſhes.—If you expoſe the aſhes " of lead to a ſtrong fire, they will melt; but the " melted ſubſtance will not be a metal, it will be " a yellow or orange-coloured glaſs.—If you " pound this glaſs, and mix it with charcoal duſt, " or if you mix the aſhes of the lead with char- " coal duſt, and expoſe either mixture to a melt- " ing heat, you will obtain, not a glaſs, but a *me-* " *tal*, in weight, colour, conſiſtency, and every " other property, the ſame as lead.

" This operation, by which a metallic earth is " reſtored to its metallic form, is called reduc- " tion. The aſhes of lead melted without char- " coal is *glaſs*;—the aſhes of lead melted with " charcoal becomes a *metal*; the charcoal muſt " then have communicated SOMETHING to " the aſhes of lead, by which they are changed " from a glaſs to a metal.

" Charcoal conſiſts of two things, of aſhes, " and of PHLOGISTON; the aſhes of char- " coal, though united with the aſhes of lead, " would only produce *glaſs*; it muſt therefore be

" the

" the other conſtituent part of charcoal, or PHLO-
" GISTON, which is communicated to the aſhes
" of lead, and by an union with which the aſhes
" are reſtored to their metallic form.

" The aſhes of lead we ſee then can never be
" reduced to their metallic form, without their
" being united with ſome matter containing
" PHLOGISTON: and they may be reduced
" to their metallic form, by being united with *any*
" ſubſtance containing PHLOGISTON in a
" proper ſtate, whether that ſubſtance be derived
" from the animal, vegetable, or mineral king-
" dom (for tallow, or iron filings, may be ſub-
" ſtituted with ſucceſs in the room of charcoal,
" in the experiment of reducing the lead); and
" thence we conclude, not only that PHLOGIS-
" TON is a neceſſary part of a metal, but that
" it has *an identity* belonging to it, from *whatever*
" *ſubſtance* it be extracted *."

The doctrine of pneumatic chemistry

It had long been obſerved, that certain ſubſtances, ſuch as *marble*, *chalk*, and *limeſtone*, effervesced with acids,—that theſe ſubſtances were inſoluble in water; they were ſoft to the touch and inoffenſive:—But when treated with fire they aſſumed directly contrary properties, not effervescing with acids;—being eaſily diſſolved by

* A complete refutation of the doctrine of phlogiſton is given at page 248, it being neceſſary firſt to give the outline of the antiphlogiſtic doctrine.

water ſo as to form a tranſparent liquor;—and laſtly, they were rendered ſo cauſtic as to corrode all animal and vegetable ſubſtances. Theſe curious phænomena had not eſcaped the notice of attentive obſervers of former times; but the honour of firſt ſatisfactorily explaining the true cauſe of theſe events ſeemed reſerved for the illuſtrious profeſſor of chemiſtry at Edinburgh,

Dr. Black.

Dr. Black. He diſcovered, that by the proceſs of fire, theſe ſubſtances loſt half their former weight, and when treated with acids the compound weighed lighter than before. *Something* therefore was loſt. In a treatiſe, which indeed is a fine ſpecimen of the beſt method of inveſtigating and demonſtrating chemical truths, he aſcertained, "*what this SOMETHING was*," and proved it to be a permanently elaſtic fluid, which he therefore denominated FIXED AIR, deprived of which the reſidue was cauſtic or *quick-lime*—having thoſe properties firſt enumerated.

Dr Rutherford.

Dr. Rutherford extended this inquiry, and determined the difference betwixt fixed, and azotic, airs.

Hitherto the exiſtence of *fixed air*, and its combination with bodies was a phyſical opinion, and no phyſiologiſt ſince Van Helmont had

Macbride.

adopted it, when the amiable and learned Macbride, profeſſor of phyſic at Dublin, examined into the medicinal properties of *this air*, and eſtabliſhed

tabliſhed by the moſt deciſive experiments, its *antiſeptic properties.* He aſcertained, that fleſh which is half putrid, having loſt a portion of the *fixed air* which enters into its compoſition, may recover its former ſweetneſs, by reſtoring to it its *fixed air*; to produce which effect, it will be ſufficient to expoſe it to the vapours of any fermenting ſubſtance, or rather to a current of *fixed air* from an efferveſcing mixture.

Soon after the publication of Dr. Macbride's treatiſe, the Hon. Mr. Cavendiſh communicated to the Royal Society ſome new experiments confirming the doctrines of theſe two eminent profeſſors. He further ſhewed that water is capable of abſorbing a volume of *fixed air* more than equal to itſelf; that this quantity is proportionably greater as the water is colder, and is compreſſed by a heavier atmoſphere; that water thus impregnated with fixed air has all the acidulous and ſpirituous taſte of Seltzar water. Mr. Cavendiſh determined the quantities of fixed and inflammable gaſes obtained from different ſubſtances: he aſcertained their ſpecific gravities: and introduced, or at leaſt ſet the example, by his accurate mode of experimenting, of eſtabliſhing a complete ſyſtem of *pneumatic chemiſtry.* *The Honourable Mr. Cavendiſh.*

Mr. Lane diſcovered that water impregnated with *fixed air* has the property of diſſolving al- *Mr. Lane.*

 moſt

moſt all metals, and eſpecially iron and zinc; a very ſmall quantity of theſe metals being ſufficient to communicate to water their taſte and virtues.

Dr Prieſtley.

Soon after Dr. Prieſtley entered upon his career, and proceeded with ſuch rapidity of ſucceſs, that he attracted the attention of philoſophers of all nations to theſe and ſimilar objects, and excited their emulation in the ſame purſuit; and thereby he has given riſe to ſuch auſpicious conſequences in chemiſtry, that his entry into this branch of experimental philoſophy will be ever conſidered as an æra in the annals of chemiſtry.

It is impoſſible to compreſs his numerous diſcoveries in the limits of a few pages. They fill up ſix volumes; and as the knowledge of the *permanently elaſtic fluids* is the moſt important part of chemiſtry, and has in a manner given to this ſcience an entirely *new appearance*, I would therefore recommend the reader to a careful ſtudy of the whole of his incomparable and entertaining works. I ſhall therefore here confine myſelf ſolely to the account he gives us of his diſcovery of *vital air*, which he denominates *dephlogiſticated air*.

Of the diſcovery of vital air.

On the 1ſt of Auguſt, 1774, I endeavoured, ſays this illuſtrious philoſopher, to extract air from *mercurius calcinatus per ſe*, and I preſently found that, by means of a very large burning-

glaſs.

glaſs, an *aerial fluid* was expelled very readily. Having got three or four times as much as the bulk of the materials, I admitted water to it, and found it was not fixed air, becauſe water did not abſorb it. But what ſurpriſed me exceedingly was, "*that when a candle was put into this*
"*newly acquired air, the flame, beſides being larger,*
"*burnt with conſiderable more ſplendour, and heat,*
"*than in common air; and a piece of burnt wood*
"*that had any redneſs in it, was rekindled and*
"*burnt away very faſt, reſembling by its crackling*
"*noiſe paper that had been dipped in a ſolution of*
"*nitre.*"

I extracted, he adds, in the ſame way, a quantity of *air*, with the very *ſame property*, from the common *red precipitate*, which had been produced by a ſolution of mercury in ſpirit of nitre, and hence I concluded that this peculiar property was derived in both inſtances from *nitrous particles*. I even thought that what was uſually ſold as the *mercurius calcinatus per ſe* was contaminated with *nitrous acid*. However, upon mentioning this ſuſpicion to Mr. Waltire, he furniſhed me with ſome, which he aſſured me was genuine. This being treated in the ſame manner as the former, only by a longer continuance of heat, I extracted much more air from it than from the other. This experiment might have ſatisfied any other; but being at Paris in the October following, and knowing that there were ſeveral very

 eminent

eminent chemifts in that place, I did not omit the opportunity to get an ounce of *mercurius calcinatus* prepared by Monf. Cadet; of the genuinenefs of which there could not poffibly be any fufpicion; and at the fame time I frequently mentioned my furprife at *the kind* of *air* I had got from this preparation to Monf. Lavoifier, and feveral other philofophers who honoured me with their notice in that city.

At the fame time that I had obtained the air above defcribed from the *mercurius calcinatus* and the *red precipitate*, I alfo procured fome of the fame kind from *minium*, or *red lead*. As I never made the leaft fecret of any thing that I obferved, I mentioned this experiment *alfo*, to all my philofophic acquaintance at Paris, and elfewhere; having no idea at that time to what thefe remarkable facts would lead.

The French chemifts, who had been inattentive to the admirable difcoveries of Dr. Black and Mr. Cavendifh, were roufed by the ftriking phænomena which Dr. Prieftley's difcoveries prefented. Their minds being prepared by the active and enlightened genius of the age, the fpark was no fooner ftruck, than the moft brilliant effects began to fhew themfelves along the French meridian. Never was the paffion for novelty, now concurring with philofophical ardour, more happily exerted among the philofophers of that lively nation, than in the cultivation

of

of this ample field of knowledge, which had been first explored, and the richness of the soil demonstrated principally by our illustrious countrymen, Mayow, Boyle, Hales, Black, Cavendish, and Priestley; of the three last of whom I shall be joined, by every lover of science, in the wish,

Sero in cœlum redeant.

But the efforts of Dr. Priestley's discoveries were not confined to France. They passed to every country in Europe, and across the Atlantic. More extensive in their influence than the commotions of Calabria, they spread their better agitations, particularly into Germany, Italy, and Sweden; in which last kingdom they met the congenial spirit of two illustrious chemists, Bergman and Scheele; the *former* distinguished by the order, precision, and various abilities with which he improved chemistry; and the *other* by so numerous a train of discoveries as could only occur to a man who, like Scheele, joined to a profound knowledge of chemistry, an intuitive genius, and a laborious zeal. The discovery of *vital air*, the pride, as it is called, of modern philosophy, had slumbered for more than a century, when this illustrious philosopher drew it forth from nitre, and a variety of other substances, and called it *empyreal air*, a word which

Bergman.

Scheele.

implies,

implies, "*formed of the element of fire,*" or "*an air pure in the extreme.*"

It is fingularly curious, that two philofophers of the prefent day fhould both, and at the fame time, and by different proceffes, difcover this *wonderful gas*, which has thrown light on the whole œconomy of nature, and both of them ignorant of the prior claim of Hook and Mayow, of whofe claim they certainly knew nothing. Dr. Prieftley and Mr. Scheele however paid the debt to humanity, being biaffed by the prevailing opinion of *phlogifton*, in which they were feconded by *Kirwan.* the ingenious and laborious Kirwan, who wrote a book exprefsly to fupport the *old theory*, as it is called.

At this time the *new*, or *antiphlogiftic theory* fprang up in France. It derived its chief origin *Lavoifier.* from Lavoifier, who had foon the felicity of being joined by Berthollet, Morveau, Adet, Hazenfratz, De la Place, Monge, Chaptal, Fourcroy, and others, who have united their labours in eftablifhing this *new fyftem*, which, from fuch a combination of talents, could not fail of being exhibited with every advantage, and of fixing the attention of the philofophic world.

[illegible] parts [illegible] combuftion. I. Thefe chemifts contend, that although the atmofphere is a vaft laboratory, in which nature operates immenfe analyfes, folutions, precipitations,

and

and combinations, although it is the grand receiver, in which all the attenuated and volatilized productions of terreſtrial bodies are received, mingled, agitated, combined, and ſeparated, nevertheleſs the *atmoſpheric air* is the ſame with regard to its *qualities*, being decidedly marked by its *two properties* of ſupporting reſpiration and combuſtion.

II. A combuſtible body cannot burn without the contact of atmoſpheric air. Thus combuſtion cannot take place in vacuum. *The proof of this.*

III. A combuſtible body cannot burn in a given quantity of atmoſpheric air, beyond a certain period. An hundred pints of this air contain only 27 pints capable of ſupporting combuſtion; when theſe 27 pints have been *united to* the combuſtible body, the combuſtion ceaſes, as the other 73 pints cannot in any way contribute to its ſupport. *Combuſtion is limited by the quantity of air.*

IV. Hence it appears, that *atmoſpheric air* is a compound of *two different airs*;—of theſe two ſubſtances, *one* ſupports reſpiration and combuſtion; this is termed VITAL AIR: the *other* is the reverſe of it, and is called AZOTIC AIR. *Combuſtion gives the analyſis of common air.*

V. Thus a burning body in the air effects a real *Vital air unites with*

the combustible body. real analysis of this fluid. It separates from it and absorbs the VITAL AIR, which augments the weight, and changes the nature of the burning body.

The qualities of the residuary air. VI. The AZOTIC AIR which remains is lighter than the atmospheric air, extinguishes bodies in combustion, and kills animals.

The true definition of combustion. VII. Combustion then consists in the *fixation* and *absorption* of VITAL AIR by the combustible body, by a true decomposition of the atmospheric air.

The qualities of the combustible body when burnt. VIII. A combustible body which has burnt in atmospheric air, and *absorbed* all the VITAL AIR to which it is capable of uniting, can burn no longer even in a fresh quantity of air: it has become incombustible, and frequently *acid*.

The origin of the term oxygen air. IX. As many bodies by absorbing the VITAL AIR are rendered *acid*, hence the term which it has also received of OXYGEN AIR, or the ACIDIFYING PRINCIPLE.

Of the disengagement of heat and light. X. There is another interesting phænomenon in combustion, which modern chemistry is able to explain; namely, that of the disengagement of *heat* and *light*.

XI. Combuſtion is not confined to the decompoſition of atmoſpheric air by abſorbing one of its principles; for it alſo *decompoſes* the VITAL AIR, by abſorbing, fixing, and rendering more or leſs ſolid, in the combuſtible body, the *oxygen*, or baſe of the vital air, and diſengaging the ſolvent of this baſe, *caloric*, or *heat*, in greater or leſs quantity.

Combuſtion alſo decompoſes the vital air.

XII. It is demonſtrated, that the light which conſtitutes *flame* is contained in the VITAL AIR, of which it is one of the principles; for combuſtible bodies afford much more flame when they burn in vital air, than in atmoſpheric air.

Light and heat component parts of vital air.

XIII. Hence it follows, that when we burn a combuſtible body, in order to procure *heat* or *light*, as we do to mitigate the rigours of winter, or to chace away the darkneſs of the evening, we obtain theſe from the *air* itſelf in which they enter as principles.

Auxiliary.

XIV. Now as VITAL AIR only ſerves to ſupport combuſtion, it is eaſy to conceive, that a very combuſtible body, capable of abſorbing the whole of the VITAL AIR, may be employed to determine the proportion of the vital and azotic airs in common air: thus phoſphorus and nitrous air are now uſed for the purpoſe of *eudiometry*,

How the goodneſs of common air may be aſcertained

metry, or to difcover the purity of the air; that is to fay, the proportion of the VITAL AIR which it contains.

Why we fhould appreciate different combuftible bodies

XV. Combuftible bodies are too various, numerous, and important in the phænomena they exhibit, and the combinations they are inceffantly entering into with each other and with the air, not to excite us to examine them with care, and endeavour accurately to afcertain their properties and fpecific characters.

The diamond is a combuftible body.

XVI. The diamond is the hardeft of all the bodies we know. It is very remarkable for the power with which it refracts and decompofes light, from which the immortal Newton rightly conjectured it was combuftible, and this is found actually to be the cafe.

Metals unite with oxygen the bafe of vital air.

XVII. Though there are various circumftances under which metals may be united with OXYGEN, they may be reduced to three.

1. The firft is the contact of *air*.
2. The fecond is owing to the decompofition of *water*, which we fhall prefently fhew is compofed principally of oxygen.
3. The third depends on *acids*.

In this triple view the oxydation and diffolution of metals are here to be confidered.

 XVIII. All

Metals are to be esteemed combustible bodies.

XVIII. All metals heated in the air, and raised to a temperature more or less high, are susceptible of burning with a vivid flame, great heat, and a true deflagration, in which process they absorb OXYGEN. Those that oxydate slowly, and without perceptible inflammation, equally disengage *light* and *caloric* from the vital air, but in so small a quantity at a time, that they are not rendered sensible to our organs.

Metals during combustion increase in weight by absorbing oxygen.

XIX. All metals increase their weight during this operation, which does not take place without the contact of air, and consequently they absorb a principle, the OXYGEN of the atmosphere, without losing any one.

Neither the name of calcination which was given to this phænomenon, nor that of metallic calces, can be retained; but instead of these have been substituted the terms of combustion and oxydation for the operation, and of metallic oxyds to denote the metals thus burnt or oxydated.

Heat increases this absorption.

XX. Elevation of temperature favours the absorption of the OXYGEN of the atmosphere by metals, and renders the combination of this principle with these combustible bodies more considerable.

Metals differ in this respect.

XXI. While there are some metals which never

ver burn in the air, except at a high temperature, as gold, silver, and platina, there are others which burn at all temperatures, even the lowest, and with great promptitude, as manganese. Some, as iron, copper, lead, burn slowly, and in the course of some months, in the air, even though cold.

Metals absorb different quantities of vital air.

XXII. Not only do all metals compared with each other absorb different quantities of OXYGEN to saturate them in their combustion by the contact of air, but each metal considered separately absorbs different proportions, and stops at various points of *oxydation*, according to the degree of temperature to which it is raised. Thus tin, lead, copper, iron, change colour and assume the tints of the rainbow, at the first degree of fire to which they are exposed in contact with the air: lead first becomes a grey oxyd, next yellow, and lastly red; mercury passes from black to white, from white to yellow, and from yellow to red; iron, at first a black oxyd, becomes next green, then brown, and ultimately white: copper is at first a brown oxyd, from which it changes to blue, and its last degree of oxydation imparts to it a green colour.

The reason why metals exhibit different coloured flames.

XXIII. The colour which metals display in burning, or with which their flame is tinged, appears to be owing to the dissolution of the metallic

tallic molecules in the light that is evolved. Thus copper yields a green flame, &c.

Before we consider the oxydation of metals in *water* and *acids*, it may be proper first to notice the composition of these bodies.

XXIV. *Water* is not a simple element, as was formerly supposed. By burning with rapidity a number of combustible bodies, more or less heated, as charcoal, red-hot iron, oil, &c. water is decomposed, yielding to these combustible bodies the OXYGEN it contained. *Combustible bodies decompose water, appropriating its oxygen.*

XXV. In proportion as the OXYGEN of the water becomes fixed in the combustible bodies which it burns, its other principle which is dissolved in the caloric forms the INFLAMMABLE AIR which is evolved. *Hence the evolution of its other principle hydrogen.*

As this second principle is one of the elements of water, it has been called HYDROGEN, and when it is an elastic fluid from its solution in light and caloric, HYDROGEN, or INFLAMMABLE, AIR.

XXVI. Reiterated experiments have proved, that water contains 85 parts in a hundred of OXYGEN, and 15 of HYDROGEN. The recomposition of water, one of the most brilliant discoveries of modern chemistry, which was made by the Honourable Mr. Cavendish, confirms the *The composition of water proved by synthesis.*

 analysis

analysis of this body: for on uniting by combustion 85 parts of OXYGEN with 15 of HYDROGEN, 100 parts of pure water are obtained.

Hydrogen air arises always from the decomposition of water.

XXVII. The HYDROGEN AIR produced in various experiments always originates from water, either in consequence of a preceding decomposition, in which it had been combined in the state of *fixed hydrogen*, with one of the substances employed, or from the decomposition of the water actually taking place in the experiments themselves.

All HYDROGEN therefore proceeds from water, and when it is in the form of *air* it has combined with caloric: and it is easy to conceive how hydrogen, one of the elements of water, acquires levity by participating of the elastic property of caloric: and, in fact, while a cubic foot of water weighs seventy pounds, a cubic foot of pure hydrogen air weighs only sixty-one grains.

Heat assists the decomposition of water.

XXVIII. The combustible bodies which decompose water, generally speaking, are those which have a greater affinity, or stronger attraction, for oxygen, than hydrogen has: but this attraction is greatly assisted by the presence of caloric, which, as we observed, united with the hydrogen, holding it in solution in the form of gas or air.

XXIX. HY-

XXIX. HYDROGEN GAS carries along with it various ſubſtances, either ſuſpended or diſſolved in it, according as the bodies are applied to the water from whence it is extricated. From the difference of theſe adventitious ſubſtances which it contains, it *varies* in ſmell, weight, and inflammability, the colour of the flame it yields, its action on different bodies, and alſo in the product which it affords in burning. Hence are derived the ſeveral ſpecies and denominations of inflammable air admitted by authors, of which hydrogen always conſtitutes the general baſis. *The different ſpecies of inflammable air.*

XXX. To recapitulate. HYDROGEN is one of the principles of water. With caloric and light it forms hydrogen air, thirteen times as light as common air, capable of diſſolving ſulphur, phoſphorus, charcoal, oil, &c. and then forming the different ſpecies of hydrogen air, formerly called ſulphurated, phoſphorated, carbonated, oleagenous, inflammable air. It imparts to all the compounds into which it enters, whether they be combuſtible or not, a conſiderable refringent power, which property led the ſagacious Newton to conjecture, that a combuſtible ſubſtance was contained in water. *The properties of hydrogen.*

XXXI. The hydrogen air being thirteen times lighter than common air, it riſes above the common air, and to the combuſtion of this air, by *The cauſe of the aurora borealis.*

means of the electric fluid, arises most probably the phænomenon of the aurora borealis.

The cause of detonations. XXXII. The disengagement of this principle in the form of gas,* which takes place wherever water is decomposed by a combustible body, is the cause of a great number of detonations and fulminations, which occur in chemical processes.

Of thunder and rain. XXXIII. It is also probable that atmospheric detonations, claps of thunder, proceed from the hydrogen air inflaming, by means of the electric fluid, in common air; and accordingly they are often succeeded by a torrent of rain.

Sudden appearance of storm. XXXIV. When in a clear day a storm on a sudden takes place, and the heavens are overcast, it is probable that this sudden formation of water in the atmosphere, arises from the rapid union of the hydrogen gas and vital air, occasioned by the necessary re-establishment of an equilibrium of electricity between different clouds, or between the clouds and the earth.

The origin of acids. XXXV. As every acid contains OXYGEN, and loses its acidity exactly in proportion as it is deprived of this principle, we ought to consider acids as burnt or oxydated substances, which are akin to each other from the presence of this acidifying principle.

XXXVI. Since

Why acids have common properties.

XXXVI. Since all acids resemble each other in their taste, their manner of giving a red colour to vegetable substances, their tendency to combine with alkalies, and metallic oxyds, and their property of attracting and being attracted powerfully, it was natural to presume, as Sir Isaac Newton observed, that they likewise resembled each other in their intimate nature, and possessed some homogeneal principle: and chemical analysis has established this as a truth beyond the possibility of a doubt.

Method of investigation.

XXXVII. The best method of acquiring a knowledge of the nature of acids is by forming them, by composing them, from their constituent parts, in uniting with OXYGEN such substances as are capable of becoming acid by an union with it.

The advance made in this branch of science.

XXXVIII. Out of thirty known species of acids, there are but three, strictly speaking, which we can either compose or decompose, so that we are necessarily ignorant of their nature; but there is no reason why we should not regard substances of this kind as accurately discriminated, and contemplate their general properties and compositions.

Why acids are differently characterised.

XXXIX. All acids being compounds of OXYGEN with DIFFERENT SUBSTAN-

CES, the *former principle* is the cause of their resemblance and common properties; the *latter*, being different in each, may serve to characterize each in particular. For this reason, those matters which are variable in acids are termed their bases, or acidifiable principles.

Of the common principle and base.

XL. Thus all acids are combinations of bases, or acidifiable substances, different in each species, with oxygen, which is the same in all: whence it follows, that their common properties, their characters as acids, depend on OXYGEN; their particular properties, their specific characters, arise from their bases.

The new nomenclature.

XLI. The word acid, indicating the general and identical nature of these substances, forms their generical name, while the particular name of the bases of each may with propriety designate each particular acid. Thus sulphur is the basis of the acid we call sulphurous, carbon that of the carbonic, and so on.

Metals decompose water.

XLII. Various metals decompose *water*, and this the more rapidly the higher the temperature is raised. Thus iron decomposes water with the greatest rapidity when much heated, though it requires a considerable time to effect its decomposition at the highest temperature our atmosphere ever attains.

XLIII. Sul-

XLIII. Sulphurous acid, diluted with water, greatly facilitates the decomposition of the aqueous fluid by means of metals, and evolves in this process hydrogen gas; this is eminently the case in the dissolution of iron or zinc by the diluted sulphurous acid. *Sulphurous acid promotes the decomposition of water*

XLIV. There are some cases in which the *water* and the *acid* are at the same time *decomposed* by the metal, as in the solution of tin in the nitrous acid. Tin is so greedy of OXYGEN, and requires so large a quantity for its saturation, that after having absorbed that of the nitrous acid, and reduced it to the state of azote, it decomposes likewise the water, and disengages hydrogen. These two principles being separated from their first compounds, unite together, and immediately form ammoniac. *Sometimes acids are also decomposed*

XLV. Metallic oxyds have different degrees of affinity with acids; hence some may be employed to decompose combinations of others. Thus several metals, by taking OXYGEN from the others which are dissolved by means of acids, occasion the re-appearance of the dissolved metal. Thus mercury will occasion the re-appearance of silver, copper of mercury, iron of copper, zinc of iron, &c. *The different affinities which metals have for oxygen*

The reduction of metals. XLVI. The reduction of metals arises from substances which have a greater affinity for OXYGEN than the metallic base, and these combine and form with this principle different compounds. Thus carbon or charcoal added to a metallic oxyd, at a certain temperature, unites with the OXYGEN of the calx, and forms carbonic acid air, or fixed air; and hydrogen air, by uniting with the OXYGEN of a metallic oxyd, or calx, forms water, while the metal is restored to its metallic splendour and its other characteristic properties.

Refutation of the doctine of Phlogiston. One may here pause a moment to consider the causes that pervert the understandings of men, and the difficulty there is to root up error when once established.—It is natural in the rudest state of science to consider the changes of property in chemical bodies as resulting from the loss or acquisition of *something*, and, if this could not be demonstrated, to give it some general appellation. Hence the term PHLOGISTON. It was this principle, which escaping from a metal during calcination converted it into a calx, or earthy substance; and it was the union of this principle which rendered the air mephitic. Here the *phlogistians* appealed to the senses.—But when these altered bodies came to be accurately weighed, it was found that 100 pounds of lead converted into minium, or calx of lead, weighed 112 pounds; and when the experiment was performed in close vessels, the volume of air was diminished during

the proceſs; and the air, after the calcination was complete, weighed exactly 12 pounds leſs than before.—This argument, which ſhook the very foundation of the *phlogiſtic doctrine*, the ſophiſtry of men, who wiſhed to indulge their deluſion, endeavoured to anſwer by ſaying, that gravity was relative; thus a cork which falls to the ground riſes in water, and PHLOGISTON having a tendency upwards, buoyed as it were each body in which it entered, and hence, when removed from the metal, its increaſe of weight, and hence the decreaſe of weight in the atmoſpheric air employed in calcination.—When it was obſerved, that this explanation would not hold in other inſtances, for when charcoal was burnt there was but a ſmall reſiduum, and this weighed *lighter* than when it had its phlogiſton, and the mephitic air on the contrary *heavier*, "Ah," ſay they, "there are difficulties in every ſcience, and we "do not preſume to explain every thing;" generally, at the ſame time, knitting the forehead and walking off.—But the *antiphlogiſtians* kept on exulting at every interview, and they examined the *mephitic air* from each proceſs, and obſerved it was ſometimes *azotic air*, ſometimes when charcoal was uſed *fixed air*, and ſometimes *water*; and when the *mercurius precipitatus per ſe* was diſcovered by Monſ. *Lavoiſier* to give out VITAL AIR which calcined other metals, giving them weight, and that when any reſidue of this air re-

maiged

mained it was not *mephitic*, and when combined with mephitic air in the proportion of one to four it made common atmospheric air, it was then that the *antiphlogistians* truly triumphed, and the VITAL AIR, which forms a fourth part of our atmosphere, became the universal *Œdipus* that unlocks all the mysteries of chemistry, the *causa sine qua non* of the antiphlogistic school.

Full establishment of the new chemistry

The *new doctrines* were combated by Dr. *Black* for ten years, who finally became a convert to it. Writing to *Lavoisier*, he says, "such is the force "of PREJUDICE, that it requires ten years to "overcome this hydra, but now I feel the force "of truth, and assent to it."—The celebrated *Kirwan* next writes to *Lavoisier*, "that he has re-"nounced his work in favour of the *phlogistic doc-"trine*, and means himself to refute it." Even Dr. *Priestley* declares, "that he has been more than "once upon the point of abandoning the doc-"trine of *phlogiston*;" and in his sixth volume he actually declares "in favour of the decomposition "of water," and adds, "nor shall I feel much "reluctance to adopt the *new doctrine*, although "I think the chemical phænomena admit of the "easiest explanation on the old system."

Respecting the nature of the composition of the *air* Dr. *Priestley* says, "for my own part I "will frankly acknowledge, that at the com-"mencement of the experiments recited, I was "so far from having formed any hypothesis that

"led

" led me to the discoveries these produced, that " they appeared to me improbable when I heard " of them; and when the decisive facts did at " length obtrude themselves upon my notice, it " was very slowly, and with great hesitation, that " I yielded to the evidence of my senses. And " yet, when I reconsider the matter, and com- " pare my last discoveries relating to the consti- " tution of the atmosphere with the first, I see " the closest and easiest connexion between them, " so as to wonder that I should not have been led " immediately from the one to the other. That " this was not the case, I attribute to the force " of PREJUDICE, which unknown to our- " selves, biasses not only our judgments, properly " so called, but even the perceptions of our " senses; for we may take a maxim so strongly " for granted, that the plainest evidence of sense " will not entirely change, and often hardly mo- " dify, our persuasions; and the more ingenious " a man is, the more effectually he is entangled " in his errors; his ingenuity only helping him " to deceive himself by evading the force of " truth."

We will not fatigue the reader by entering more deeply into the *new* or *antiphlogistic doctrine* respecting those bodies which have no vital principle, and which are therefore distinguished as belonging to the mineral kingdom.

The difference between the mineral and vegetable kingdoms.

XLVII. In the *mineral kingdom*, we are juſtified in referring all the phænomena to the action of external bodies, and the ſimple law of affinity affords deductions ſufficient to account for all its changes. In the *vegetable kingdom*, on the contrary, we are compelled to acknowledge a vital principle which preſides over every thing, and performs many chemical proceſſes which we poor mortals attempt in vain to imitate.

Plants are diſtinguiſhed by poſſeſſing a living principle.

XLVIII. That plants have a *living principle* is evident by the motion of the ſenſitive plant, which we may excite at pleaſure; by the ſpontaneous motion of the hedyſarum gyrans; the retraction of the ſtamina of the ceſtus; the advance of the ſtamina to the piſtillum in other flowers; by the leaves turning to the light; and ſome plants following the ſun; by their cloſing againſt rain; by the roots turning out of their direction to plunge themſelves into water, or a more favourite ſoil, &c.

They reproduce their ſpecies.

XLIX. The reproduction of *vegetables* is effected in the ſame manner as that of *animals*; and modern botaniſts have ſupported the compariſon between theſe two functions in the moſt concluſive manner.

Their relation to air.

L. *Vegetables* require the ſame kind of air as *animals*.

LI. The

LI. The *great difference* which exists between *vegetables* and *animals* is, that the latter *in general** are capable of conveying themselves in search of nourishment; whereas vegetables, being fixed in the same place, are obliged to take up in their own vicinity all such materials as are capable of nourishing them: and nature has therefore provided them with leaves, to extract from the atmosphere the air and water, while the roots extend to a distance in the earth to take firm hold, as well as to imbibe water and the fixed air contained within the bowels of the earth.

They have no locomotive power.

* Oysters, muscles, polypi, &c. connect this chain, and seem as it were intermediate links, having no locomotive power.

SECT.

LAWS OF THE ANIMAL ŒCONOMY.

SECT. III.

ON STIMULI.

AFTER *aſtronomy* had ſhewn, that the immenſity of ſpace was filled with innumerable worlds, revolving round innumerable ſuns; thoſe worlds themſelves the centers of others, ſecondary to them, all attracting, all attracted, enlightened, or receiving light, and at diſtances unmeaſurable, did the immortal Newton diſcloſe to the aſtoniſhed world *the laws which theſe obeyed.*

In like manner, after *anatomy* had demonſtrated a wonderful complicated ſtructure of the human body, the parts ſo delicate, and their relations to, and influence upon, each other ſo immenſe, has another Newton, as it were, demonſtrated, that all theſe ſeveral parts *obey the ſame great and fundamental laws.*

This was the memorable diſcovery of the late Dr. Brown, a *noted* author and teacher of phyſic, as he is ſtyled by Dr. Cullen, whom the prejudice of old age, and the pride of celebrity, con-

ſpired from receiving his doctrines and who would fain perſuade himſelf that the author, whom he *notes*, and againſt whom he proteſts, was really contemptible. For my part, ſays the illuſtrious Dr. Beddoes, I conſider Dr. Brown's doctrine of *excitement* as a moſt perfect ſpecimen of extenſive reaſoning, truly calculated to afford the fulleſt ſatisfaction to a juſt thinker. He avoids thoſe unmeaning and vague terms, that had before been ſo much uſed to ſhelter ignorance from their employers and from others; he appeals to the phenomena of the living ſyſtem obvious to the ſenſes; and adopts ſuch principles of reaſoning, that if he has not always diſcovered the truth, he is never forſaken by the ſpirit of a true philoſopher. Dr. Darwin, who is no leſs eminent as a phyſician than a poet *, entertains ſimilar ſentiments with reſpect to the *Brunonian doctrine*, and allows his work to be, with a few exceptions, a performance of *great genius*. I do not mean here, however, to defend Dr. Brown's perſonal conduct, which perhaps more than any thing elſe cauſed his doctrines to be condemned unheard, as if the groſſneſs of a man's manners affected the concluſiveneſs of his arguments. If his imprudence, however, was highly blameable, and his arrogance intolerable, the liberal will allow ſomething

* The celebrated author of *The Botanic Garden*, or *Loves of the Plants* and of *Zoonomia*.

to

to the deep consciousness of *neglected merit*, and to the irritating sensations attendant upon *declining health*: and posterity will perhaps reproach an age, in which a man, possessed of powers, *so superior*, and *so nobly exerted*, was brow-beaten, defamed, even driven from his country by shameless persecution *, and left to perish in *London* in extreme penury. But to return to the main object of this part, *the laws of organic life*.

* Thank heaven! such *arts* cannot *now* prevail. Knowledge and improvement gain ground every day. Men of science, not bred to the profession, have begun to exercise *their own judgment*; and when that comes generally to be the case, *true merit* must be *encouraged*, many *abstruse* doctrines of *old physicians* will be exploded; and the tyranny of *empty pomp* and *learned mystery* in physic will be driven out of the land, and forced to seek shelter among less cultivated societies of men. *Philosophic instructions* on the important subject of health, delivered in a familiar way, cannot injure in the least *medical men*, who have the high advantage of *experience* together with *education*, for no sober man of common sense will trust the *salvation of his soul* to a *cobbler*, nor employ a *taylor* to defend *his property* in Westminster-hall. I am, therefore, fully persuaded, that when the *thinking part* of the nation are taught the *laws* of the *animal œconomy*, or *philosophy of medicine*, men in general will feel it their duty to support the *regular faculty*, and will be weaned from being *quacked* by *miscreants*, who are *as little qualified to practise physic*, as a *cobbler* is to preach, or a *taylor* to plead a cause, or a *mender of kettles* to repair (an instrument *of far less complicated structure than the human body*) your watch.

STIMULI

STIMULI are the *exciters* of *actions* in animated bodies, and are of *two kinds*,

1. *Direct*, producing *tone*, or *strength*, in the *fibre*;—and an *expenditure* of the *irritable principle*:
2. *Indirect*, producing *atony*, or *weakness* in the *fibre*;—and an *increase* of the *irritable principle*.

ACTION, or EXCITEMENT, in animated bodies, is the *retrocession* of the *fibre* upon the application of *stimuli*; and is in *proportion*,

1st. To the *strength* of the *fibre*,

2d. The *quantity* of *irritable principle*,

And 3d. The *degree* of *stimulus* applied.

THE LAWS OF THE ANIMAL ŒCONOMY are *the changes* that the *fibre* and *irritable principle* undergo upon the application of *stimuli*.

The laws of organic life, when fully explained, are so obvious to every thinking mind, that it seems surprising they were not earlier elucidated, and brought forward to solve a number of difficulties respecting health and diseases, and the proper method of preserving the one and removing the other. On account of their great simplicity, and their easy application in medicine,

 I durst

I durst not, says the learned Dr. Beddoes, at first believe them to be true. They apply equally to the muscular and sentient fibres, which therefore throw much additional light and confirmation on each other.

Every age, every habit, if the excitement by *stimuli* be properly directed, has its due degree of vigour arising from it. *Childhood*, as possessing *abundant excitability*, admits of *moderate stimuli*; with an under proportion, it becomes *languid*; with excess, it speedily feels *oppressed*. In *the middle period of life*, where the *excitability* is in *due power*, a *moderate stimulus* is requisite to stir up all the actions of life. *Old age*, on the contrary, owing to a *deficiency* of *excitability*, requires a *great deal* of stimulus; it becomes *enfeebled* by too little, and quickly *overset* by more *.

In

* This verifies the old adage, "*Milk* is the food of *infancy*, and *wine* of *old age*." What calumnies have not been thrown out against John Brown for this doctrine? If *low living* and *starving* are reprobated for the facts and reasons that presently will be assigned, why, therefore, should he be called a friend to *intemperance*? On the contrary, he only approves and tries to adjust the *proper standard*, condemning all *extremes*, and advising the *mean* under which *virtue* takes her post. If he has any way erred in this *difficult* but *honourable attempt*, as he certainly did not err *wilfully*, I know not why he should be held up as a *criminal*, or *censured* with *greater asperity* than the exploded theories of Boerhaave or Cullen. This knowledge will assuredly,

as

In one word, *excitement*, the effect of *stimulating powers*, when of a *proper degree* and *suited to the person*, constitutes *firm health*; when either *excessive* or *deficient*, proves the occasion of *weakness* and *disease*.

To obtain some conception of the grandeur of this subject, only imagine to yourself, by the *Almighty Fiat*, a stop put to the *movement* of all things. There would no longer be the succession of night and day, the changes of the seasons, the growing of the different productions of the earth, nor wind, nor rain, nor circulation, nor secretion, nor life. On the contrary, *nature* is ever performing her eternal rounds, and, obedient to the *great command*, we pass onwards from a specklike beginning to manhood, and from man-

as Dr. Beddoes justly observes, become a part, and the most important part, of education. Physiological ignorance is the most abundant source of *our sufferings*; every person *accustomed* to the *sick*, must have heard them deplore *their ignorance* of the *necessary consequences* of *those practices*, by which their *health* has been *destroyed*; and when men shall be deeply convinced, that the *eternal laws of nature* have connected *pain* and *decrepitude* with *one mode of life*, and *health* and *vigour* with *another*, they will avoid the *former*, and adhere to the *latter*. And as actions are often named immoral from their effects, self love, or the enjoyment of health, are *so far* the same. Nor is this sort of morality likely to terminate in itself; but the habit of acting with thought and resolution, will *extend* from the selfish to the social actions, and regulate the whole tenour of life.

 hood

hood to old age. While we are thus running our course of life, every thing within us is in a *conſtant movement*. If we have exiſted even but a few years, the blood has been circulating from the heart through the lungs, and the body, *countleſs times*; and the ſtomach and inteſtines have been performing *innumerable* wave-like motions.

We have before ſhewn that the *motion* of the heart and arteries, the ſtomach and inteſtines, depended on the *retroceſſion* of *irritable fibres* from *certain ſtimuli*; in the following ſections we ſhall conſider the *effects of different ſtimuli* * on the human body.

* As Heat, Light, Air, Food, Exerciſe, &c.

LAW I.

A due Excitement of the Fibrous and Nervous Syſtems is neceſſary for the Maintenance of Health and Vigour.

OUR

RELATIONSHIP

TO

AIR.

INTRODUCTION.

SECT. IV.

OF CHEMICAL ATTRACTION.

PREVIOUS to our explaining the laws of *chemical attraction*, we ſhould firſt briefly contemplate the *attraction of gravitation*, or that power which draws bodies to the centre of the earth. It is from this law that different bodies in the creation aſſume their proper ſtation, heavy bodies deſcend, and light ones aſcend; by this, projectiles are directed, vapours and exhalations riſe, and rains fall; by this, rivers glide, the air preſſes, and oceans ſwell. If we extend our mind, we ſhall perceive that this law alſo governs all the planetary worlds. Projected by the almighty *fiat*, they would roll on through the infinitude of ſpace in ſtraight lines, but the central ſuns overcoming in part this power by *the law of gravity*, hence each planet forms his own reſpective circle: but

but *chemical attraction*, or the *attraction of cohesion*, we are about to consider, is that principle which joins and combines into little systems those several and distinct corpuscules which form different substances. It is that *attractive force* by which they tend mutually towards each other, which force only exists in the very point of close contact, at little distances is less, and at a little further distance is quite insensible.

The *attraction of gravitation* acts only upon large bodies, and is always in proportion to their masses; whereas *chemical attraction* affects only minute bodies, and has absolutely no influence upon such as are of any considerable bulk. *Gravitation* acts upon bodies placed at immense distances from each other; whereas *chemical attraction* never acts but with bodies in mutual contact.

We see then that these two attractive powers are different, and they are not natural to inert bodies, but a property implanted by the *Creator* no less confounding to the philosopher than that amazing property in animal bodies, which we denominate the life or soul.

This property of dead matter is of three kinds.

The first is where the integrant parts are united by a very considerable force, and forms the *hard* or *solid aggregate*. Thus two smooth

plates

plates of any metal placed in contact, will ſo firmly adhere as to ſupport many hundred pounds. Thus the particles of a diamond are ſo cloſely united, as to make one of the hardeſt ſubſtances in nature. This genus comprehends many ſpecies from the hardneſs of rock-cryſtal to the yielding contexture of the ſofteſt wood.

The ſecond is called the *pliant*, or *ſoft*, or *fluid aggregate*, where the parts may be eaſily moved backwards and forwards ſo as to change their relative ſituation: as wax, putty, and water.

And third, the *aeriform*, or *gaſeous*, *aggregate*, the tenuity of whoſe integrant particles renders them imperceptible, and in which the attraction of coheſion is the leaſt poſſible.

Theſe *three ſtates* are however, properly ſpeaking, but *one* and the *ſame power*, and moſt probably owe their diſtinctive difference to *caloric* or *matter of heat*, which pervades all bodies. The better to determine our ideas relating to this ſubject, which has not hitherto been ſufficiently conſidered, let us, for a moment, conceive what would take place in the various ſubſtances which compoſe our earth, if its *temperature* were ſuddenly altered. If, for inſtance, we were tranſported

ported into the region of the planet *Mercury*, where probably the common temperature is much superior to that of boiling water. The rivers of the earth, and all the other fluids which are susceptible of the gaseous state, at the temperature near to that of boiling water, would become rarefied; and all these substances would be changed into permanent aeriform fluids or gases, which would become part of the new atmosphere.

By a contrary supposition to the one we have been forming, if the earth was suddenly transported to where the *Georgium Sidus* is, or some planet equally cold, the water which composes our seas, rivers, and springs, and probably the greater number of the fluids we are acquainted with, would be converted into solid mountains and hard rocks, at first transparent and homogeneous, like rock crystal, but which, in time, being mixed with different coloured earths, would form opake stones of various colours In this case the air would lose its elasticity for want of a sufficient temperature to retain it in that state: it would return to the liquid state of existence, and new liquids would be formed, of whose properties at this moment we have not the most distant idea.

Although these two hypotheses may give a tolerable distinct idea of our position, that *solid, liquid*, and *aeriform aggregates* are only three different states of existence of the same matter, or three particular modifications, which almost all sub-

ſtances are ſuſceptible of aſſuming ſucceſſively, and which ſolely depend upon the degree of *temperature* to which they are expoſed; or upon the degree of *caloric* with which they are penetrated; yet as this opinion is the baſis of all chemical ſcience, I ſhall enter a little further into the conſideration of this very important ſubject in the next ſection.

GENERAL LAWS RESPECTING HEAT.

SECT. V.

LAW.

ALL BODIES ARE EXPANDED BY HEAT.

1st. State of Expanſion.

As compariſons with ſenſible objects are of great uſe in aſſiſting us to form diſtinct notions of abſtract ideas, we ſhall endeavour to illuſtrate this poſition, by inſtancing the phænomena which takes place between water and bodies which are penetrated by it. If we put a loaf of bread into water, this fluid will gradually inſinuate itſelf into its pores, and the bread is ſoon conſiderably augmented both in weight and magnitude.—Or if we put a piece of wood into water, it will ſwell by admitting the water into its ſubſtance.—Or if a dry ſponge be dipped in water, the ſponge ſwells, its particles are ſeparated from each other, and all its intervals are filled up by the water. The ſame circumſtance undoubtedly takes place with regard to bodies which are immerſed in free *Caloric* *. Thus if you take an iron tube, which is

* Diſtinguiſhed thus from latent or combined heat.

filled up exactly by a rod, and heat this rod, it will be found too large for the tube, and will not enter it: and if you put it by the side of the tube, you will find it also longer than the tube, which when cold it appeared so exactly to fit. Its dimensions are therefore *increased* both in diameter and length. It is so with the rings on the finger. The ring which in health appeared exactly to fit, will drop off in the cold fit of an ague, and will be found on the contrary immoveable during the hot fit. It is upon this principle, that vessels and the wheels of carriages are bound with hoops heated red hot, and applied in this their expanded state, after which they pour cold water upon them, when the iron contracts with such force as to make a deep impression on the wood, and in this way the vessels are bound much faster than they would be by any other means. It is also upon this principle that our *thermometers* are constructed.

The first invention of this curious and useful instrument is somewhat obscure: but previous to the time of *Sanctorius* it does not appear that the expansive power of heat was much observed. *Sanctorius's* thermometer was a hollow glass ball, with a long cylindrical tube attached to it, with a small opening at the top, and therefore containing a quantity of air, and in order to observe the variation of the bulk, or elasticity which the air in the ball and tube underwent from the application

plication of heat, he firſt expelled a ſmall quantity of air out of the veſſel by applying heat to it. In conſequence of which the air expands, and a ſmall quantity of it comes out. He then puts the extremity of the tube immediately into a coloured liquor, and allows the veſſel to become cool again; the conſequence is, that the air loſes the increaſe of its elaſticity, and the internal air preſſes up a quantity of the fluid into the tube to fill up the room of the air that had been expelled by the heat, and having thus ſet up his thermometer, he then applied to the tube a ſcale of equal parts or degrees, which divides the cavity of the tube into a number of ſmall and equal parts; and as the tube is cylindrical, we can ſee by theſe diviſions, how the bulk of the air is increaſed at one time, and diminiſhed at another. This kind of thermometer was uſed for a conſiderable time, when at laſt it was objected to by the honourable Mr. Boyle, that it could not be employed to aſcertain the temperature of fluids, and owing to the changes which are known to take place in the weight of the atmoſphere, it was fallacious even in thoſe caſes in which it could be employed; he therefore attempted to conſtruct a thermometer on ſome other ſubſtance than air, and *ſpirit of wine* was firſt thought on, upon account of its being eaſily tinged, and the conſiderable change of bulk that it undergoes; and it was very eaſy to contrive the manner of confining the

ſpirit

ſpirit of wine, or any other fluid, ſo as to obſerve diſtinctly the ſmalleſt variation of its bulk by putting it into a ball and tube, whereby a quantity riſes in a ſmall and ſlender thread, which can be eaſily meaſured, and divided into a number of ſmall parts, the extremity of the tube being ſealed hermetically, ſo that the preſſure of the atmoſphere could not affect it, nor could it ſuffer any loſs from exhalation; thus the firſt uſeful thermometer was contrived by the Honourable Mr. Boyle. Theſe thermometers were uſed for twenty or thirty years, till Dr. Halley and Sir Iſaac Newton preferred *mercury*.

The *pulſe glaſs*, as it is improperly called, depends alſo upon this principle. It is a bulb with a long neck to it. As the heat of the hand, following its natural tendency, immediately paſſes into the colder ſpirit of wine, in proportion as it enters it increaſes its bulk, and makes it gradually riſe higher into the neck of the veſſel, till it has acquired its utmoſt limit, when it appears to bubble; and to ſhew that it depends upon heat merely, it will do the ſame if immerſed in hot water; and then if it be removed it will again diminiſh in bulk, and return to its former place.

Before I quit the ſubject of *expanſion*, it may not be improper to notice, that a knowledge of this law enables us to underſtand the effect produced upon bodies that are remarkably brittle. Chemiſts know this but too well, and in private

families glaſſes are repeatedly broken by pouring into them warm water, and even the backs of grates are ſoon cracked if cold water be thrown upon them after they are quickly heated. In theſe caſes the particles are torn from the colder parts by the expanſive power of heat.

2d. State of Expanſion, or that of Fluidity.

The firſt expanſion carried a little further produces the ſtate of *fluidity*. That this depends upon *abſorbed heat* merely, is proved by the following experiment. If you take a quantity of ice, and put it into a baſon, and carry it to a room in which the thermometer is at 50 degrees, from the increaſed temperature, owing to a fire in the chamber, and leave this ice for ſome time in the room, part of it will be melted. Apply then a thermometer, and it will point to 32 degrees. The ſame in five minutes, though evidently more heat has entered the mixture, and ſo continually until every particle of ice, or ſnow, has been melted. This can only be accounted for by ſuppoſing that the free caloric, or heat, has entered into combination with the water, and remains, as chemiſts are wont to call it, in a *latent* ſtate. That is, the capacity of water for heat is greater than that of ice.

We may readily form an idea of the word *capacity*, by ſuppoſing a veſſel filled with marbles, into

into which a quantity of fine ſand is poured, which, inſinuating into the intervals between the balls, will fill up every void. The marbles in this compariſon are to the ſand which ſurrounds them exactly in the ſame ſituation as the particles of bodies are with reſpect to the caloric, with this difference only, that the marbles are ſuppoſed to touch each other, whereas the particles of bodies are not in contact, being retained at a ſmall diſtance from each other by the intervention of the caloric. If, inſtead of ſpherical balls, we ſubſtitute ſolid bodies of a hexahedral, octohedral, or any other regular figure, the capacity of the intervals between them will be leſſened, and conſequently will no longer contain the ſame quantity of ſand. The ſame thing takes place with regard to natural bodies, the intervals left between their particles are not of equal capacity, but vary in conſequence of the different figures and magnitude of their particles, and the different figures and magnitude of their particles are maintained, according to the exiſting proportion between their inherent attraction, and the repulſive force exerted upon them by the caloric. In this manner we muſt underſtand the following expreſſion, introduced by the Engliſh philoſophers, who have given the firſt preciſe ideas upon this ſubject, namely, the capacity of bodies for containing the matter of heat.

It is upon this principle alſo that *frigorific mixtures* are formed. The city of *Peterſburgh*, which is contiguous to the ſea, is expoſed to a very in-

 tenſe

tenſe degree of cold, and that of the year 1760 being very exceſſive, the mercury ſtood even at 40 degrees below that of Farhenheit's ſcale. This being the caſe, Profeſſor Brown, of the academy there, had the curioſity to try whether by mixing together ice and ſtrong nitrous acid he could congeal even mercury itſelf, and the artificial cold this produced was ſo great, that he actually accompliſhed his experiment, and the mercury in the bulb was converted into a tough metal, which bore a ſtroke or two of the hammer; and what was in the bore turned out a very fine and flexible thread. Thus if a mixture of ſal ammoniac and ſnow be put over a fire, and we place in the middle of this a bowl with ſome water in it, whilſt the ſnow and ſal ammoniac is melting into a liquid, the water in the bowl will be congealed into a maſs of ice. We can have no doubt here, but that heat enters into bodies as they become *fluid*, ſeeing it torn in ſo ſurpriſing a manner from water during the melting of the ſnow. We ſee then, that in the change of the ice from the *ſolid* to the *fluid form*, it *abſorbed* a quantity of *heat*, even ſo much as to render mercury ſimilar in its properties to all the other metallic bodies.

3d. State of Expanſion, or the Aeriform State.

If you put a cup of æther in a baſon of water, and place them in the exhauſted receiver of an air-

air-pump, the æther will aſſume an aeriform ſtate, and the water in the baſon will be frozen. In this experiment we ſee, that in the ordinary temperature of the earth, æther would always exiſt in an aeriform ſtate, but for the preſſure of the atmoſphere, and that the paſſing of the æther from the liquid to the aeriform ſtate is accompanied with a conſiderable diminution of heat; becauſe during the evaporation a part of the caloric, which was before either free or latent in the ſurrounding bodies, combines with the æther, cauſing it to aſſume the aeriform ſtate.

The effect of the preſſure of the atmoſphere in the converſion of bodies into theſe different ſtates was firſt noticed by the honourable Mr. Boyle. He found, when making experiments with the air-pump, that water boiled at 90 degrees when the preſſure of the atmoſphere was taken off, and that therefore both the freezing and boiling points upon thermometers were in ſome meaſure defective, being dependant upon the height of the barometer; for when the preſſure was greateſt the water bore more heat, and vice verſa.

In conſequence of this diſcovery Papin formed his *digeſter*. In this inſtrument bones may be diſſolved, and the water may be made to acquire ſo great a degree of heat, that an iron wire will melt in it. For a deſcription of this inſtrument ſee Vol. II. page 98.

Before we quit this ſubject, let us for a mo-

ment consider the cause of the *elasticity* of *air*. It is by no means difficult to perceive that this elasticity depends upon that of *caloric*, which seems to be the most eminently elastic body in nature. Nothing is more readily conceived, than that one body should become elastic by entering into combination with another body possessed of that quality. Elasticity is nothing more than that quality of the particles of bodies by which they recede from each other when forced together. We shall be satisfied of this, when we consider that air is susceptible of undergoing great compression, which supposes that its particles were previously very distant from each other, for the power of approaching together certainly supposes a previous distance, at least equal to the degree of approach.

The acquisition of this property exhibits some of the most curious phænomena we are acquainted with. As children we have been often delighted with *candle crackers*, but we should now contemplate them as men. They are hollow pieces of glass formed upon the extremity of a tube. This tube is made to contain a drop or two of water, and it is then hermetically sealed. When this is put near the flame of a candle, the water soon acquires the form of steam, the elasticity of which is gradually increased, until it bursts the glass with an exceeding loud crack, and with such violence, that usually the wick of the candle

is

is beat down upon the tallow as if it had received the blow of a hammer.

The diſtillation of ſubſtances depends wholly upon this principle. Steam or vapour is produced by the elaſtic power of heat. This we have before ſhewn to vary with the preſſure of the atmoſphere. Accordingly it is found, that when the air is light (indicated by the barometer being low) the fluid will boil ſooner. When the barometer ſtands at 30 inches, water boils at the temperature of 212 degrees. If it ſtand ſo low as 28 inches, water will boil at 208. Hence in diſtillation we ſhould diminiſh the preſſure of the atmoſphere. It is undoubtedly of great advantage to be able by the ſecluſion of air to work with ſmaller fires, and this would ſecure us alſo in a great meaſure from thoſe fatal accidents which are often attended with the moſt terrible effects. Monſ. Lavoiſier was employed with his chemical friends on this important ſubject, when the Goth* of the eighteenth century, and his colleagues in iniquity, deprived the world of this great philoſopher. The flimſy pretext was that he occupied the place of farmer-general, a receiver of taxes under the former government, but the real motive which produced this execrable action was the juſtly acquired riches which he was known to poſſeſs. Thus was cut off the Newton of the preſent age in the midſt of his

* Robespierre.

uſeful labours; his houſe, filled with the moſt expenſive chemical apparatuſes, free for his numerous viſitants, was deſpoiled; and the honourable rendezvous of men of letters was converted into a den of political thieves. When ſhall we find again combined equal ſpirit, induſtry, and great abilities, which an ample fortune enabled him to employ in their fulleſt extent! A great northern genius, when he had occaſion to mention this circumſtance, overcome by generous feeling, was unable to proceed, and was obliged to decline continuing the lecture. A century may not be able to repair the loſs. It is however hoped, for the advancement of ſcience, that the ſubject will not be entirely dropt. The laws which regulate the formation of elaſtic vapour, and the phenomena they exhibit, give us that link which cloſely connects chemiſtry with mechanical philoſophy. Here we ſee chemical agents and mechanical forces ſet in immediate oppoſition to each other, and the one made the indication and meaſure of the other.

The *ſteam engine*, is the name of a machine which derives its moving power from the elaſticity of the ſteam of boiling water. It is the moſt valuable preſent which the arts of life have ever received from the philoſopher. The mariner's compaſs, the teleſcope, and other moſt uſeful diſcoveries, were the reſult of chance, and we do not know to whom we are indebted for them;

but the ſteam-engine was, in the very beginning, the reſult of reflection, and the production of a very ingenious mind; and every improvement it has received, and every alteration in its conſtruction and principles, were alſo the reſults of philoſophical ſtudy. This invention was made in the reign of Charles II. by the Marquis of Worceſter, which he publiſhed with ninety-nine other contrivances of his own, which he extols, as of the higheſt importance to the public. It does not, however, appear that the noble inventor could ever intereſt the public by theſe accounts. He was branded as a projector, and the many failures which perſons of this turn of mind daily experience, probably prejudiced people againſt him, and prevented all attention to his projects. The ſcheme however was revived in the year 1696 by Captain Savary, but it owes its preſent improved ſtate to the philanthropic Mr. Watt, a perſon of a truly philoſophical mind, eminently converſant in all branches of natural knowledge, and the pupil and intimate friend of Dr. Black, whoſe illuſtrious name will be often mentioned in this work, having of late turned his attention much towards the improvement of medicine by the formation and introduction of new aerial remedies, as alſo to the ingenuity of the Rev. Mr. Cartwright.

Without entering more diffuſely into examples of the conſequences of the change of capacity in bodies

bodies when they are altered in their form, it may be obſerved, and repeated once more, that as the powers of *gravity* and *projection*, in continual oppoſition to each other, produce all the beautiful effects in the great ſyſtem of the univerſe; ſo, among the actions of the minute parts of bodies, the *cohesive attraction*, and the *repulſion* of *heat*, are in continual oppoſition to each other, and are concerned in almoſt every proceſs by which changes are produced in the peculiar properties, or chemical combination, of bodies.

To conclude. Beſides the extenſive influence of *heat*, chemiſts, in order to deſtroy as much as poſſible THE ATTRACTION OF COHESION, employ the mechanical operations of *pounding*, *hammering*, *raſping*, *filing*, or *cutting*, and not unfrequently the operation of *ſolvents*. Hence that adage, "Corpora non agunt niſi ſint ſoluta;" by which means they give free ſcope for THE ATTRACTION OF COMPOSITION, or AFFINITY, or that attraction which takes place between bodies of different natures.

SECT.

SECT. VI.

THE ANCIENT OPINION RESPECTING OUR ATMOSPHERE.

FORTUNATELY for my readers, the chemical knowledge neceffary firft to be learnt in order *clearly* to underftand the *influence* of *air* on the *blood*, and *thence* on the *animal economy*, comprifes the *moft beautiful difcoveries* in that fcience; *difcoveries* that have done honour to the laft century and this age, and have immortalized the names of Hook, Mayow, Prieftley, Lavoifier, Fourcroy, and Cavendifh.

The Honourable Mr. Boyle has confidered *our atmofphere* as *one large chemical veffel*, in which an infinite number of various operations are conftantly performing. In it all the bodies of the earth are continually fending up a part of their fubftance by evaporation, to mix in *this great alembic*, and to float a while in common. Here minerals from their loweft depths afcend in noxious vapours to make a part of the general mafs; feas, rivers, and fubterraneous fprings, furnifh their copious fupplies; plants receive and return their fhare; and animals, that by living upon confume this general ftore, are found to give it back in vaft quantities when they die.

The

The *air*, therefore, which every where preſſes on us, and upon which we ſubſiſt, bears very little reſemblance to that *pure, ſimple, elementary body* generally imagined; and which is rather a ſubſtance that can be conceived, than experienced to exiſt.

Chemiſtry, however, has made great advances in *this curious reſearch*, and it will ſoon appear that the compoſition of atmoſpherical air has been more *rigorouſly* determined.

SECT. VII.

THE MODERN ANALYSIS OF ATMOSPHERIC AIR;

Or its Separation into 2 Elastic Fluids, { 1. VITAL AIR. 2. AZOTIC AIR.

Chemistry affords two general methods of aſcertaining the conſtituent principles of bodies, the method of *analyſis* *, and that of *ſyntheſis* †.

When, for inſtance, by combining *water* with *alkohol*, we form the ſpecies of liquor called *brandy*, we certainly have a right to conclude (by this ſyntheſis) that *brandy* is compoſed of *alkohol* and *water*. And when by diſtillation of *brandy*, we obtain ſeparate, *water*, and *alkohol* (by this analyſis), our evidence of the conſtituent principles of *brandy* is then rendered complete; and in general it ought to be conſidered as *a principle* in chemical ſcience, never to reſt ſatisfied without *both theſe ſpecies of proofs*.

* From the Greek word ἀνάλυσις. The *ſeparation* of any *compound* into its *ſeveral parts*.

† From the Greek work σύνθεσις. The *putting together* the *ſeveral parts* of a *compound body*.

LAVOISIER'S FAMOUS EXPERIMENT.

This illuſtrious chemiſt having placed 83 *grains* of fluid *mercury* in a *retort*, adapted to a *bell glaſs*, which encloſed 100 *cubical inches* of *common air*, he kept up in his furnace a conſtant fire, of ſuch force, as to keep the *quickſilver* almoſt always at its *boiling point*.

On the ſecond day ſmall *red particles* began to appear on the ſurface of the *mercury*, which gradually increaſed in ſize and number for 4 or 5 days.

Convinced that the *calcination* of the *mercury* after that time did not go on, he extinguiſhed the fire; and when the veſſel was cool, he found in his bell-glaſs, inſtead of 100 *cubical inches of air*, only 86, and therefore *a loſs* of 14 *cubical inches* of *air*.

Now, 14 *cubical inches* of *air* weighs 7 *grains*, and the *red particles* or *calx of mercury*, being carefully collected, weighed 90 *grains*. The *mercury*, therefore, by being calcined, had acquired an *increaſe of weight* of 7 *grains*, the *exact weight* of *air* which ſeemed *loſt* *.

The 86 *cubical inches* of *air* remaining in the

* The concluſion is obvious, and in the next experiment we ſhall find, that the 14 *cubical inches of air*, which was *abſorbed* by the *mercury*, and converted it to a *calx*, was the *vital* or *reſpirable part* of our air.

glaſs

glaſs after this calcination was ended being examined, it was found to poſſeſs *theſe diſtinguiſhing properties*.

An animal being put into it was *ſuffocated* in a few minutes,—and when *a taper* was plunged into it, it was *extinguiſhed*, as if it had been immerſed in water *.

This gas, or *air*, has been called *phlogiſticated air*, *non-reſpirable air*, *noxious or mephitic air*, *impure air*; but the French chemiſts have preferred the term *azotic gas (lethal air)* from the Greek words *α*, *privative*; and *ζωη*, *life*, as *this air* ſo quickly deſtroys life.

LAVOISIER'S SECOND EXPERIMENT.

HAVING taken 90 *grains* of the *calx of mercury*, the product of the *laſt proceſs*, Lavoiſier put it into a glaſs retort fitted to a proper apparatus for receiving aerial products.

Having applied a *much ſtronger heat* than in the former experiment, he obſerved that at firſt, in proportion as the *calx* of *mercury* became heated, the intenſity of its colour augmented; but ſoon

* Not from any peculiar property of its own, but becauſe the *vital* or *reſpirable part* was abſtracted from it, as will be ſeen from the next experiment.

after the *calx* began gradually to decreaſe in bulk, and in a few minutes *its red colour altogether diſappeared*, and the 90 *grains of calx of mercury* was converted into the 83 *grains* of *running mercury*, and 14 *cubical inches* of an *aerial fluid* paſſed over into the recipient.

Now theſe 14 *cubical inches* of air weighed 7 *grains*, the *exact weight* of the air *conſumed* by the *calcination* of the *mercury* in the firſt experiment *; and the 83 *grains* of the *calx* of *mercury reduced* † to a *metallic ſtate* being examined, had *loſt in weight* 7 *grains*, the *exact weight* of the air now obtained. *This air* poſſeſſed theſe *peculiar properties*.

An animal being placed in *it*, became *remarkably lively*; a *taper* burnt in it with a *dazzling ſplendour*; and *charcoal*, inſtead of conſuming quietly away, as it does in common air, burnt *with a flame*, attended with a decrepitating noiſe, and threw out ſuch a *brilliant light* that the eyes could hardly endure it.

* Had the 100 *cubical inches* of atmoſpheric air contained a larger ſhare of *oxygen* or *vital air*, *more mercury* would have been *calcined*. For *calcination*, as this experiment ſhews, is nothing more than the *combination* of *vital air* with *any metallic* body.

† From the Latin word *reduco*, *to bring back*. *Reduction* is the bringing back a *metal converted into a calx* in its *priſtine ſtate*.

the

This ſpecies of air was *diſcovered* * almoſt at the ſame time by Dr. Prieſtley, Mr. Scheele, and Lavoiſier. Dr. Prieſtley gave it the name of *Dephlogiſticated* or *Pure Air*; Mr. Sheele called

* I know that ſome of the moſt eminent philoſophers of the preſent day give to MAYOW the priority of the diſco- of *vital air*. Having at laſt procured the ſcarce work of writer, I was not a little ſurpriſed to find, that he had been very much over-rated. I have before proved that HOOK had anticipated him in many of his opinions. They both thought that the air contained in ſolution certain heavy *particles*, as aqua-fortis (the nitro- id) after diſſolving copper contains *particles* of copper ſpenſion. That theſe *fire particles* were in calcination and combuſtion, precipitated, juſt as when you put a piece of iron in a ſolution of copper in aqua-fortis, and the ſurface of the iron is immediately covered with copper, and from the *motion* of theſe uniting particles, *heat* was produced. Mayow has given a full chapter to prove that nitre did not contain *air*, but only ſolid *fire-particles*, and another to prove that theſe gave to the air its *elaſticity*! All which ſeems to me to prove that MAYOW had not the ſmalleſt knowledge of *vital air*, nor indeed a juſt conception of our atmoſphere, which modern philoſophers have proved to be compoſed of two *diſtinct airs*, viz. VITAL, and AZOTIC, AIRS, and that in combuſtion, and calcination, not only a true decompoſition of the *air* takes place; but alſo of the *oxygen, or vital, air*, by which *heat* and *light* are liberated. Dr. Prieſtley, in 1774, ſeems, therefore, without knowledge of theſe obſolete and antiquated, I might ſay, falſe, ideas of Mayow, to have *diſcovered* a permanently elaſtic fluid, purer than common air; but amidſt the variety of objects in the purſuit of his experimental inquiries, he then overlooked,

 or

called it *Empyreal Air*; and Lavoisier first named it *Highly respirable Air*, or *Vital Air*; and afterwards, as it forms acids, by combining with certain bodies, he adopted the term *Oxygen Gas* (*Acid-making Air*), from the Greek words οξυς, *sour*; and γεινομαι, *to beget* *.

THE

or rather neglected to consider, the phænomena of this wonderful fluid, which, of modern philosophers, was first presented to his view. Nearly about the time that Dr Priestley discovered the *Dephlogisticated air* in England, Mr Sheele, of Sweden, was engaged in making experiments on air and fire, which he published in German; and in those experiments we find also the discovery of *vital air*, called by Mr. Scheele, *Empyreal air*, both of whom appear wholly unacquainted with each other's discovery, which is confirmed by each of these philosophers arriving at the same *conclusion by* different roads: but undoubtedly Lavoisier was the *first* who proved, by direct and exact experiments, that the weight which metals gain by *calcination* corresponds with that of the air which they absorb; he was the *first* who ascertained, by the most decisive experiments, that the atmosphere consists of *two distinct fluids*, the *one* fit for the purposes of respiration and combustion, which he therefore called VITAL, or PURE AIR; the *other* unfit for either purpose, and thence called FOUL, or MEPHITIC AIR; he *first* proved that *vital air* contained more *fire*, or *caloric*, than any other species of air; and that during combustion, as this air, or rather its *base*, was uniting to the substance, and adding its weight to the burning body, it gave out this *fire* in the form of *heat* and *light*

* If *sulphur* or *charcoal* be burnt in *oxygen* or *vital air*, in a close vessel, and the fumes be condensed in water, *this water* will acquire an *acid taste*, and be increased *in weight*

THE SYNTHESIS,

Or Reunion of { 1. VITAL AIR, AND 2. AZOTIC AIR.

Lavoisier then repeated the same experiments as before related, and *re-combined* the 2 *elastic fluids*, which he had separately obtained in the two experiments of *calcination* and *reduction*, viz. the 84 *cubical inches* of the AZOTIC AIR, and the 14 *cubical inches* of the OXYGEN AIR, and he produced from *this combination* an *elastic fluid precisely similar in all its properties to atmospheric air*, contributing in the same way to a repetition of the same experiments, and possessing the same power of supporting animal life, and combustion.

weight exactly *corresponding* to the *weights* of *sulphur* or *charcoal* consumed, and *that* of the *oxygen air* destroyed. *Sulphur* united thus with *oxygen*, the fumes being collected in water, will form *vitriolic acid*; and *charcoal* combined with *oxygen*, and diffused in water, will form the *carbonic*, or *aerial acid water*.

The *calces of* metals the French chemists call *oxyds*, which signifies a body impregnated with a *certain quantity* of *oxygen*, but not *sufficient* to render it *perceptibly acid*

CONCLUSION.

The philosopher can have no remaining doubt as to the *composition* of *atmospheric air*: but the circumstances of these experiments might appear to him *more correct*, though probably at the time *less clear* to others, were it said, that *mercury*, at a certain temperature, overcoming the affinities * of *caloric* † and *azotic air* for

* If you take a bullet and divide it with a knife into *two parts*, provided these be smooth and rubbed together, they will strongly unite and form *one whole*. This is from a law impressed on matter called the *attraction of cohesion*. But should a particle of sand, or any roughness exist, the particles being divorced from each other, beyond the *sphere of mutual attraction*, they are no longer actuated by this law —*The attraction of cohesion* in *mercury*, at the common temperature, hinders the admission of *oxygen*, for which it has an *elective attraction* or *affinity* But when exposed to a strong heat, the *caloric* expands this fluid; that is, insinuates itself through the body, and separates its particles (thermometers depend on this expansive power of fire), and, like the pieces of the bullet where sand interposed, the divided particles are no longer subject to the *law of cohesion*; then it is they obey the *law of attraction*, and each atom of *mercury attracts to itself* a particle of *oxygen*, just as a loadstone would draw to itself a particle of iron.—The loadstone *only attracts* iron. This represents the term *affinity* in chemistry. The mercury did not attract the *azot*, because chemists would say it had no *affinity* for it.

† *Fire*, or the *matter of heat*.

oxygen,

oxygen, attracts and fixes within itself *oxygen* *, (the *base* of oxygen air, for oxygen air is oxygen combined with a certain quantity of caloric:)—hence its *increase of weight*, and its *conversion into an oxyd or calx*, and hence the *azotic*, or *lethal*, *air left us* in the bell-glass.—That the temperature being increased †, the affinity of the *caloric* for *oxygen* becoming now superior to the attraction of the *mercury*, the *oxygen* is withdrawn from the *oxyd of mercury* by the superior attraction of the *caloric*;—hence its *decrease in weight*, and its *restoration to fluidity and splendour*,

* An experimentalist would illustrate this by placing a *needle* between *two magnets* of different powers. This would represent oxygen between the two attractions of the *caloric* and *azotic air*. As we may suppose a *loadstone* to have an attraction for the *needle* superior to the *two magnets*, so would it draw *the needle* to itself from *these*, just as the *mercury* draws away from the *azotic air* and *caloric*, the *oxygen*.

† This is a curious fact, the temperature being increased, the *caloric alone* overcomes the elective attraction of *mercury* for *oxygen*, and depriving it of *that principle*, the *attraction of cohesion* takes place with the particles of *mercury*, and we obtain then *running mercury* and *oxygen gas*. To have recourse to the note on page 292, the *oxygen* and *mercury* being separated beyond their *sphere of attraction*, the *caloric* attracts to itself *oxygen*, just as either of the *magnets* (in the preceding note) would again attract to itself the *needle*, were it placed within its *sphere of attraction*, but *beyond that* of the *loadstone*.

and hence the produce of *oxygen*, or *vital*, *air*, clearly displaying to us this important truth.

"*That atmospheric air is actually a compound of* "*two heavy substances, azot* * *and oxygen* †; *which* "*bodies, when combined with caloric, or the matter* "*of heat, are aeriform, and may be procured in* "*separate states*, viz. *in the condition of vital and* "*azotic, air, which being mixed in a certain* "*proportion constitutes our atmosphere* ‡."

* That *azot* is a *solid substance* as well as *oxygen*, can be easily proved by experiment, consult page 39. That the application of heat should render *oxygen* and *azot gaseous*, is not wonderful, since we often observe *ice* by the admixture of *caloric* rendered a *fluid*, and heated to 212, converted into an aeriform and transparent gas. The hardest substance in the world, the *diamond*, may be volatilized in the same way. Mon. D'Arcet took a sphere of porcelain china, and after cutting it into halves, confined a *diamond* in the middle; he then joined the two sections strongly together. Putting these balls into a furnace, he afterwards unscrewed them, and found the diamonds evaporated, and the place which they occupied empty, though he could perceive no chink or fracture any where over the surface of the ball!

† The distinction betwixt air and vapour is this, both are formed of *particles* held in suspension by caloric, or heat, but by cold, or condensation, vapours return to their original form, whereas *airs* continue *permanently elastic*.

‡ In our climate the proportion generally is 3 of *azotic air* to 1 of *oxygen air*, as will be hereafter proved.

SECT.

SECT. VIII.

THE ANALYSIS OF OXYGEN AIR.

THAT *oxygen gas* is compoſed of $\left\{\begin{array}{l}\text{1. OXYGEN,}\\ \text{2. CALORIC,}\\ \text{3. \& LIGHT,}\end{array}\right.$ will be *evident* from the following very elegant experiment made by the celebrated Dr. Ingenhouſz.

A fine *iron wire*, twiſted into a ſpiral *, being heated at its extremity red hot, and thruſt into a jar containing only *oxygen air*, it inſtantly took fire, and burnt away rapidly †, exhibiting a bright light ſimilar to that of Chineſe fire-works, throwing out brilliant ſparks, which fell to the bottom in the form of round globules ‡.

* This was done to render the experiment more ſtriking.

† This experiment ſhews that *azotic air* retards the union of *oxygen* with bodies attracting it, which in ſome caſes altogether prevents it.

‡ Theſe were found floating on the mercury, and are natural *Martial Æthiops*. How much ſlower is the *calcination* or *ruſting* of *iron* in other circumſtances!

At the beginning of the combuftion there is a flight augmentation in the volume of the air in the bell-glafs, from the dilatation caufed by the caloric or heat; but prefently after a *rapid diminution* takes place, and *the mercury rifes in the glafs*, infomuch that when the *quantity of iron is fufficient*, and the *oxygen air operated on is very pure*, almoft the *whole air employed* is *abforbed**, —or fhould the *quantity of iron be infufficient*, the *remaining air unabforbed* will be found *perfectly pure vital air* †.

The *theory* of this experiment is the fame as the laft. At a certain temperature *iron* has a *ftronger affinity* for the *oxygen*, than *caloric* and *light* have. It *therefore* attracts to itfelf the *oxygen*, and *caloric* and light becoming difengaged ‡, are rendered *active* and *evident* to the fenfes.

The

* That is, if 100 *grains* of *iron* be confumed in 70 *cubic inches of oxygen air*, the whole volume of air will difappear; and as 70 *cubic inches* of *oxygen air* weigh 35 grains, the 100 *grains* of *iron* will weigh, in its ftate of *oxyd* or *calx*, 135 grains.

† As *pure* or *oxygen air* is found unaltered, the *mephitic air* left us in the *calcination of the mercury* could arife only from the *abftraction* of the *oxygen air*.

‡ As the calcination of the *mercury*, in the firft experiment, lafted feveral days, the *difengagement* of *caloric* and *light* was extremely fmall for each particular moment of time, and therefore not perceptible to the fight. The heat,

The burning of all bodies is then nothing more than the *decompoſition* of *oxygen air*. It is the *air*, therefore, and not the combuſtible body, that gives out *light* and *heat*.

When we are failing on the water in a ſtill day, *diſtinct objects appear to meet us*, but our reaſon corrects the deluſion. When we behold the ſun, moving from eaſt to weſt, philoſophy again aſſumes its empire, and we are convinced it is *ſtationary*. If we take a *priſm*, it diſplays to us a variety of colours; our reaſon tells us here alſo, that *theſe colours* ariſe from the *rays of light*, and are not *in the priſm*,—ſo of the combuſtion of bodies, the *caloric* and *light* are not from *the wax* of our candles, but from the *oxygen air*, which, as we have ſeen in the above experiment, becomes, under certain circumſtances, *decompoſed*.

heat, alſo, of the furnace was confounded with it, which made it neceſſary to relate Dr. Ingenhouſz's experiment, where *the combuſtion* of the metal was more rapid, and unconnected with any furnace.

SECT. IX.

THE SYNTHESIS

OF

WATER,

Or its formation from its 2 CONSTITUENT PARTS, { 1. HYDROGEN. 2. OXYGEN.

Water and *air*, says Sir Isaac Newton, composed of old worn particles and fragments of particles, would not be of the same *texture* and *nature* now as at the beginning, did not the *primitive particles* of *matter* continue *entire*, and *compose bodies* of one and the *same nature and texture in all ages*. The *changes* of *corporeal things* are to be placed only in the *various separations* and *new associations* of *these permanent particles*. OPTICS, page 376.

PREVIOUS to our entering upon the subject of the effects of air on the animal economy, it will be necessary to shew, also, that *water*, though it be the solvent of a vast variety of bodies, is neither that *compound* or *simple element* formerly supposed, but made up of two *very distinct* and *different principles*.

The new and beautiful doctrine of the French chemists, respecting the composition of *air*, the

natuee

nature of *combuſtion*, *calcination*, &c. was daily gaining ground, and obtaining the applauſe of every one, when an experiment performed by Dr. Prieſtley made it for a while totter on its baſis.

In the middle of a long glaſs tube this great experimentaliſt put ſome *calcined lead*, and affixed to the extremities *bladders* which were filled with *inflammable air* *. Having applied a ſtrong heat to the middle of this tube, he next ſqueezed the bladders, and forced the *inflammable air* along the tube.

The *inflammable air* ſoon diſappeared; no *oxygen gas* was evolved: but the *red lead* quickly *reaſſumed* its original metallic ſplendour.

A queſtion then aroſe, whence *this property* in *inflammable air* which the *antiphlogiſtians* would aſcribe to the evolution of *oxygen gas* †.

The

* *This air* Dr. Prieſtley obtained from *diluted* vitriolic acid poured on iron. *Iron* was therefore ſaid to contain a great quantity of *this air*. But the fact will ſoon appear that the air aroſe from the *decompoſition of the water* mixed with the vitriolic acid. *Inflammable*, or *hydrogen, air*, being 15 times lighter than common air, it is employed for balloons.

† *Inflammable air* quickly deſtroys life, whereas *oxygen gas* appears to be the very principle of life. *It* is conſiderably lighter than either *oxygen* or *common air*. *It* explodes when it comes into contact with *common air*, but more

The favourers of the new syſtem were not able to deny the fact; and as the *inflammable air*, which was now called *phlogiſton*, had in this experiment *diſappeared*, they found ſome difficulty to perſuade *the ſupporters of the old doctrine* that the *revival of the metal* could not be from the *abſorption* of the *inflammable air*, as the *red lead* had *loſt* a good deal of its *weight*, and the *effect* of an *addition of matter* (if *inflammable air* be *matter*) could be no other than to give it *an increaſe* of *weight*.

Fortunately for chemiſtry the Honourable Mr. Cavendiſh, by paſſing an electric ſhock through *oxygen air* blended with *inflammable air*, produced *water* *. *The reduction* of the *red lead* in Dr. Prieſtley's experiment was then no longer a matter of ſurpriſe. At a *certain temperature* the *inflammable air* overcoming the attraction of the *lead* for *oxygen* divorced it of *that principle*, and uniting with it formed *water*.

more eſpecially with *oxygen air*, provided any body in actual inflammation be preſent. The difference therefore between theſe two airs is great.

* 85 grains, by weight, of *oxygen air*, and 15 grains of *inflammable* or *hydrogen air*, produced here preciſely 100 grains of *water*. In this experiment *caloric* is diſengaged, and the 85 parts of *oxygen* and 15 of *hydrogen* unite, which, being naturally *ſolid ſubſtances of themſelves*, become, if nearly all the *caloric* be extracted from them, *ice*; it leſs, *water*.

THE

THE ANALYSIS,

OR

Its separation into { 1. HYDROGEN AIR,
2. & OXYGEN AIR.

But that no doubt may be entertained on this head, I muſt beg leave to relate an experiment which was performed by Meuſnier before a large aſſembly of the Academy of Sciences at Paris.

He took a *gun-barrel*, into which he put ſome thick pieces of *iron-wire* flattened by the hammer. He *weighed* the whole with a ſcrupulous exactneſs. He then *luted* the gun-barrel to ſecure it from the immediate contact of the fire. It was then placed in *a furnace*, but ſo *inclined* that water would readily glide down it. He adapted to the upper extremity a *funnel* containing water, from which it could not eſcape into the gun-barrel but drop by drop. This funnel was *cloſed at the top* to avoid any the leaſt evaporation of the water. At the lower extremity *veſſels* were adapted to receive any aerial product. To uſe every precaution *theſe* were exhauſted of their air.

The *gun-barrel* was now made red hot, and

the *water* from the funnel paſſed into it drop by drop.

An aſtoniſhing quantity of *inflammable air* * was quickly obtained.

Having removed the luting, the *gun-barrel* with its *contents* weighed conſiderably *heavier* than *before*; and *the acquired weight* of the gun-barrel being *added* to the *weight* of the *inflammable air* thus produced, was *preciſely* the *weight* of the *water expended* in the proceſs: and the *iron-wire* found in the barrel (the proceſs being over) reſembled in every reſpect *iron* that has been conſumed in *oxygen air*, that is, it was become an *oxyd of iron*, which accounts for the *oxygen*, the other conſtituent principle of water.

Another proof that *water* is compoſed of *hydrogen* and *oxygen* may be drawn from the cebrated experiment of Mr. Watt. This illuſtrious chemiſt wet powdered charcoal, and put it ſo moiſtened into a retort. Fire being applied, *hydrocarbonate air* † is ſoon formed; that is, *hydrogen*

* This *inflammable air* was generated from the *hydrogen* of the water, which united with the *caloric* of the furnace in its paſſage through the barrel. *Inflammable air* the French chemiſts call *hydrogen gas*, from the Greek words *υδωρ water*, and *γεινομαι to beget*.

† This air, which is applied medicinally, was the happy diſcovery of Mr. Watt. This benevolent philoſopher alſo

drogen air, or *inflammable air*, mixed with fixed air, which, in the next ſection, we ſhall find is compoſed of charcoal and *oxygen*.

alſo taught phyſicians an eaſy proceſs for obtaining *vital air*. His ſimple apparatus is a furnace, in which is placed an iron retort filled with finely powdered *mangane ſe*. An iron gun-barrel enters the mouth of the retort, and at its other extremity is connected with his *pneumatic receiver*, or with any veſſel filled with, and immerſed over, water. The furnace is then filled with charcoal and lighted, and *vital air* is obtained very rapidly, and in conſiderable quantity. The luting that Dr. Thornton diſcovered to be the beſt is glazier's putty mixed with ſand.

SECT.

SECT. X.

THE ANALYSIS OF CARBONIC ACID AIR, OR FIXED AIR;

Or its ſeparation into its 2 CONSTITUENT PARTS, $\left\{\begin{array}{l}\text{1. CHARCOAL,}\\ \text{2. OXYGEN AIR.}\end{array}\right.$

MR. TENANT, a famous chemiſt of Emanuel College, Cambridge, having procured a glaſs tube hermetically ſealed at one end, luted it over with clay and ſand to prevent the ſudden action of the fire. He then introduced into it ſome *phoſphorus* and powdered *marble* *, and having cloſed the open extremity, he applied to the tube a quick heat, and the reſult was, when cold,

1. *Phoſphoric acid* † combined with *calcareous earth.*

2. *Phoſ-*

* If *vitriolic acid* be poured on *marble, fixed air* is given out in great abundance. Mr. Tenant therefore aſſumes this data, *that marble contains fixed air.* As the reſidue is *vitriolic acid* and *calcareous earth, marble* is known alſo to contain *calcareous earth.*

† *Phoſphorus* and *oxygen.* The anſwer to this natural queſtion

2. *Phosphorus* combined with the *same earth.* And

3. A *black substance,* which differed in nothing from *charcoal* made from vegetables.

If *vitriolic acid* * be poured on *marble, this acid* possessing a superior power of combination or attraction for the *calcareous earth* of the marble, than the *carbonic acid* † has, it unites with the *calcareous earth,* and the *carbonic acid,* becoming disengaged, attracts to itself *caloric* ‡, and escapes in the form of *gas* ‖.

Marble is therefore a compound of 3 *bodies,*
1. *Oxygen,* combined with
2. *Charcoal,* or *the carbonic acid*; and
3. *Calcareous earth.*

The *theory of* Mr. Tenant's *experiment* will be now easily understood.

question, *Whence this oxygen?* is clearly demonstrated over leaf.

* *Sulphur* and *oxygen.*

† *Charcoal* and *oxygen.* *Fixed air* is *charcoal, oxygen,* and *caloric.*

‡ The *caloric* proceeds in part from the *vitriolic acid,* which acid, if poured on *water,* will almost make it *boiling hot,* to the no small astonishment of persons unacquainted with chemical operations. Since *two cold bodies,* coming into contact with each other, give out *heat, caloric* we see may be in a *dormant* or *neutralized state,* and that in condensation of oxygen into bodies, only a part of the *caloric* is disengaged from the vital air.

‖ Viz. *Carbonic acid gas,* or *fixed air*; which is *charcoal* (carbon), *oxygen,* and a certain quantity of *caloric.*

At a certain temperature *phosphorus* (which is a simple body) overcoming the attraction of the *charcoal* for *oxygen*, deprives the *carbonic acid* of its *oxygen*, and becomes, in consequence,

1. *Phosphoric acid* *, which unites with the *calcareous earth*.

The *phosphoric acid* being *saturated* † with the *calcareous earth*, we have also,

2. *Phosphorus* united with *calcareous earth*. And,

3. The *charcoal* of the marble is left us in its *simple state* ‡.

The proof, however, by synthesis, that the constituent principles of *fixed air*, are *charcoal*, and *oxygen air*, is more beautiful, as being easier understood.

* *Phosphorus* and *oxygen*.

† If *diluted vitriolic acid* be poured on marble, an effervescence denoting the extrication of *fixed air* is seen, when the union of the *vitriolic acid* and *calcareous earth* is *complete*, it is said to be *saturated*, the effervescence now ceasing.

‡ The *oxygen*, with which it was before combined, being separated from it, by the *superior attraction* of the *phosphorus*.

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THE SYNTHESIS,

Or Union of the $\left\{\begin{array}{l}\text{1. CARBON,}\\ \text{2. \& OXYGEN AIR.}\end{array}\right.$

This *charcoal** Mr. Tenant then burnt in *oxygen air*, which was converted into an *acid gas*, whofe *weight* equalled the fum of the *weights* of the *charcoal* which had been burnt, and the *oxygen air* employed.

Fixed air, or the *carbonic acid air*, is compofed of 28 parts of CHARCOAL to 72 of OXYGEN AIR; or, in other words, 144 cubic inches of *oxygen air* will faturate or take up 28 grains of *charcoal*.

This acid gas had all the *properties* of *fixed air*. It was readily upon agitation *imbibed by water* †, which acquired the fparkling appearance and tafte of Pyrmont and Seltzer water. *This acidulated water* diffolved iron filings, and became a perfect

* *Any charcoal* would have given the fame product.

† We owe our firft knowledge of *fixed air* to Dr. Black, but that *water* abforbed *this air* upon agitation, and was made Seltzer or Pyrmont water, and that if *iron filings* be put into *this acidulated water*, it becomes a *chalybeate*, we are indebted to the happy induftry of Dr. Prieftley.

 chalybeate

chalybeate water. *This air*, like *fixed air*, weighed *heavier* than *common air*. A *candle* being put in it, was quickly *extinguiſhed*, and *an animal* died *convulſed in it.*

Having ſufficiently explained the chemical compoſition of ſubſtances that have a moſt important part to perform in the animal economy, (as will be preſently ſeen) we will now proceed to the conſideration of the other properties of atmoſpheric air.

SECT. XI.

OF THE WEIGHT OF THE AIR.

As light as air, is an expreſſion made uſe of in common converſation, yet it is much heavier than is commonly imagined. We have numberleſs proofs of its weight, many of which though the ancients could eſtimate as well we, yet they conſidered it as a ſubſtance totally void of gravity, and called it an element. An element was different from earthly matter, and therefore they conſidered it as wanting ponderoſity. However all material ſubſtances, of which air is one, have weight; like other bodies it falls to the earth, and is more denſe as it approaches its centre. Every one knows that air on the tops of high mountains is much rarer and thinner than it is below in the valley; if any ſhould doubt it, the difference they will find in drawing their breath in the different places will ſoon convince them. As they go up a very high mountain their breathing becomes quicker, the atmoſphere becomes clearer, neither clouds nor vapours are able to riſe to ſuch heights, and therefore as he aſcends the traveller leaves the tempeſt and the ſtorm midway below him. Ulloa, who went to

take the meaſure of a degree upon the Andes in Peru, which are the higheſt mountains in the world, tells us, that when clouds gathered below the mountain's brow while he ſtood on the top, they ſeemed like a tempeſtuous ocean all daſhing and foaming beneath him, here and there lightnings breaking through the waves, and ſometimes two or three ſuns reflected from its boſom. In the mean time he enjoyed a cloudleſs and ſerene ſky, and left the war of the elements to the unphiloſophical mortals on the plain below him.

Such appearances as theſe, with which the ancients might be as well acquainted as we, ſhould have led them to conſider the air as having weight; but they were not at this time acquainted with a machine which ſerves to diſcover its weight by proofs much better calculated for conviction than thoſe brought from untried nature. The machine I mean by which we ſo plainly diſcover the weight of the air, is the air-pump. For the firſt invention of this, the world is indebted to Otho Gueric, a German: but it was our countryman Boyle who turned it to real uſe, it was he who improved it, and applied it to philoſophical purpoſes. In the hands of Gueric it was a mechanical inſtrument; in thoſe of Boyle it was a truly philoſophical machine. By it we can with eaſe empty a glaſs veſſel of its air, and put what bodies into it we think fit. Thus comparing the changes wrought upon bodies by be-

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ing kept from air, with the ſame bodies when expoſed to air, we come to a preciſe knowledge of the effects of air upon bodies in general.

By means of this inſtrument the firſt thing we learn is, that the air is actually heavy. If a veſſel be by means of the air-pump exhauſted of its air, if we clap the palm of our hand to its mouth we ſhall quickly perceive the weight of the air upon the back of the hand, preſſing the hand in a manner into the veſſel. If a part of the ſkin of a bladder ſhould be placed there inſtead of the hand, the external air would break the ſkin with great force, and ruſh into the veſſel with a noiſe. If the air be pumped out of a ſquare glaſs veſſel, the weight of the external air will break the glaſs into ſhivers. But to put the air's weight paſt all doubt, we can actually weigh it in a balance, and it is there found heavy.

Having exhauſted the air out of a thin glaſs flaſk, and ſuſpended it at one end of a balance, which being nicely counterpoized by weights in the other ſcale; this done, admit the air into the flaſk, into which it will ruſh with a noiſe, and though the flaſk was balanced before, it will now upon the admiſſion of the air become heavier and preponderate. If the flaſk holds a quart, it will be found that the weight of the air it now contains is about ſeventeen grains above what it was when quite empty, ſo that a quart of air

 weighed

weighed upon an average in the open air, is about ſeventeen grains.

Now, if a ſingle quart of air weighs ſo much, what would not a pillar of air weigh, the baſe of which reſts upon earth, and whoſe top reaches ſeveral miles above the clouds? The weight of ſuch a pillar, how extraordinary ſoever it may ſeem, can be determined with the niceſt preciſion. We mentioned juſt now with what extreme weight ſuch a pillar reſted upon the back of the hand which had no air under it to keep it up, or balance the weight above it, but we cannot preciſely tell how great that force is as yet. Let us go a little farther then, and ſee with what weight this high pillar of air would preſs upon the ſurface of a tub of quickſilver. Let us ſuppoſe a long glaſs tube exhauſted of all air, and ſtopped cloſe at the top, to be plunged at the other end into it. It is evident that the air will preſs upon the ſurface of the quickſilver without; and if there were air in the tube, it would preſs upon the ſurface of the quickſilver within the tube alſo: but there is no air at all, as was ſaid, within the tube, for that was exhauſted before the experiment; ſo that in ſhort all the air will preſs upon the quickſilver on the outſide of the tube, and none upon that within. The air, therefore, as it has great weight, will preſs the external ſurface of the quickſilver all over, and drive it up into the hollow of the tube, where there is no preſſure

from air at all. As if I preſſed down the palm of my hand upon water, the water would riſe up between the interſtices of my fingers where the preſſure was leaſt: by means of this preſſure of the heavy air upon the quickſilver, the quickſilver will be driven up into the tube, and riſe in it, if the tube be long enough, about twenty-nine inches and an half high.

Thus then the air preſſes down with a weight capable of making quickſilver riſe to twenty-nine inches and an half. A pillar of air therefore that reaches to the air's greateſt height, is juſt as heavy as a pillar of quickſilver of the ſame diameter that meaſures exactly twenty-nine inches and an half. For the weight of the air preſſing down muſt be juſt exactly equal to the weight of the quickſilver that is preſſed up. When one body raiſes another to its higheſt pitch, and can raiſe it no more, the body raiſed then equals the body raiſing. We may therefore boldly conclude, that a pillar of air which reaches from the top of the atmoſphere, weighs juſt as much as a pillar of quickſilver twenty-nine inches and an half high. The weight of ſuch a pillar we can eaſily eſtimate, and conſequently meaſure the weight of the atmoſphere; but firſt let us mention another caſe ſimilar to this of the quickſilver, which is water.

If by any means we exhauſt all the air from a veſſel more than thirty-two feet high, and ſtopping

ping one end, ſet the other in water, the water will riſe thirty-two feet within the veſſel and no higher, for the weight of the air will preſs upon the ſurface of the external water as it did before upon the ſurface of the quickſilver, and preſs up the one as well as the other with all its weight. A pillar of water of thirty-two feet high juſt weighs equally with a pillar of quickſilver twenty-nine inches; the air therefore preſſes up that thirty-two feet, as it preſſed up this twenty-nine inches. The weight therefore of a pillar of the atmoſphere is equal to either a pillar of quickſilver twenty-nine inches high, or to a pillar of water thirty-two feet high; it is equal to either, for they are equal to each other.

I ſhall mention an obvious experiment to this purpoſe, which the ſtudent can put into practice without any apparatus while at tea. Some water being poured into a ſaucer, let him burn a bit of paper in a tea-cup, which will rarefy and exhauſt and make a vacuum in the cup. Then while the paper is yet burning, let him turn it down paper and all into the ſaucer, and the air without will preſs the water up from the ſaucer into the cup. The water will ſtand within the cup in a column, and if the cup were thirty-two feet high, and the air within it perfectly exhauſted, the water would riſe ſo high in it, as we have ſaid before.

If what has been ſaid is well underſtood, the ſtudent

ſtudent will be at no loſs to account for the riſing of water in pumps, or the ſtanding of the quickſilver in the barometer.

All theſe appearances in nature are performed, as was ſaid, by the weight of the air preſſing the fluids into places where there was no air, nor any other reſiſtance. But though theſe truths are now as obvious as they are aſtoniſhing, yet for many ages the cauſes of the aſcending of water in pumps was utterly unknown. Philoſophers were content with thinking after Ariſtotle, and his opinion was, that nature hated a void or empty ſpace, and therefore made all poſſible efforts to fill it when the art of man had made one. All this may be very true; but we want to know, why nature hates this void? And here their philoſophy was puzzled. Torricelli was the firſt who undertook to explain, as we have ſeen, why nature made haſte to fill up this void. An accidental experiment put him into the right road towards the diſcovery. Having filled a tube, which was ſtopt at one end, with quickſilver, and then fixed this tube with its open end in a tub filled with the ſame: the quickſilver in the tube did not all deſcend into the tub, but ſtood in the tube at the height of twenty-nine inches and an half. This experiment was ſoon communicated to the learned of Europe: the genius of the times all over Europe was then employed in queſt of new diſcoveries; Boyle, Paſchal, and Riccioli, ſet themſelves to conſider

confider this new phænomenon; and this led them to the following conclúfions. Water rifes in a void thirty-two feet high, as we have for ages feen in pumps; quickfilver ftands twenty-nine inches high, as we fee in this new experiment; a pillar of the one weighs exactly as much as a pillar of the other; the afcent of both therefore muft be afcribed to one and the fame caufe. And why may not this caufe be owing to the preffure of a pillar of air? And if the preffure of this pillar of air were taken away, would the quickfilver then ftand in the tube? Let the Torricellian tube, veffel, quickfilver, and all, be placed under the glafs of the air-pump, and let the weight of the air be taken away from the quickfilver; it will then be found to ftand no longer fufpended in the tube, but will fink down to the fame level with the reft of the quickfilver in the veffel in which it is placed. This was enough, and indeed fully fufficient to convince them, they purfued the track of light where it led, and at length they deduced a theory of the air equally clear and convincing.

We mortals, who are upon the furface of the earth, faid they, refemble fifhes at the bottom of the ocean: like them we are enveloped in a fluid of air, which rifes far above our heads, an ocean of atmofphere, which while on earth we cannot quit. This atmofphere furrounds our whole earth for fome miles high, enveloping the earth on

on every ſide. Let us ſuppoſe the tops of the higheſt mountains thruſting up their heads through this great fluid, like rocks in the ocean that almoſt riſe to, but not quite ſo high as the ſurface. As the parts of this ambient atmoſphere are all heavy, they preſs down one upon another, and thoſe parts that are loweſt will ſuffer the greateſt preſſure, as they have the greateſt number of parts above preſſing them down. The lower vallies, will, therefore, ſuffer greater preſſure from the atmoſphere than the higher mountains. Let then the Torricellian tube be brought into a low valley: here the preſſure upon the quickſilver will be greateſt, and it will riſe above twenty-nine inches and an half. Let it be now brought up to the top of an high mountain: here the preſſure will be leaſt, and it will ſink down proportionably. On the ſummit of Snowdon-hill, Dr. Halley found the barometer above three degrees lower than at the bottom. On the ſummit of an Alpine mountain, the Abbe Nollet found it a quarter leſs high than on the plains of Piedmont. Thus therefore the tube of Torricelli, by the quickſilver riſing or falling, will ſerve very exactly to meaſure the weight of the air.

As the quickſilver in the tube ſometimes in the ſame place ſtands an inch or two higher, and ſometimes ſeveral inches lower, than twenty-nine inches and an half, it is very plain, that the air is ſometimes heavier and ſometimes lighter: that

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when heavier, it presses up the quicksilver above twenty-nine inches; when lighter, the quicksilver suffering less pressure rises not so high.

The tube therefore will exactly determine these variations, and its heights will alter with every change. This instrument was first called the Torricellian Tube; but being now made use of for measuring the alterations and weight of the air, it is called the Barometer, or Weather-glass. The simplest, and perhaps best method of making the barometer is thus: a glass tube, of about thirty-five inches, hermetically sealed at one end, is to be filled with quicksilver. Hermetically sealing a glass is no more than holding the end in the flame of a candle, or fire, until the glass softens, and then twisting it round, so as quite to close up the orifice, it being first filled with quicksilver well purged of its air, which is done by boiling the quicksilver in water. The finger being then placed on the open end, this end is set into a bason of the same prepared mercury. Then upon removing the finger, the mercury in the bason will join with that in the tube, and that in the tube will sink down to about twenty-nine inches and an half, one time with another. Instead of a bason at the bottom, the lower end is usually turned up, and dilated into a sort of cup, containing a quantity of quicksilver; upon which the air presses, and so drives it up along the bend of the tube to the usual height. This tube thus

fitted and filled is then faſtened to a board, which has the inches marked upon it; and towards the top thoſe inches are divided into their parts, in order to meaſure the riſing and falling of the quickſilver more preciſely. (Vide Nollet, fig. 25, vol. II. plate 5.)

An inſtrument contrived in this manner will pretty nearly ſerve to meaſure the weight of the atmoſphere; it will not preciſely meaſure its weight, becauſe it is affected alſo by another property of the air, namely, its elaſticity or ſpring, as we ſhall ſee in its proper place. By this inſtrument we learn, that the air is changing its weight continually, being ſometimes more heavy, ſometimes more light; but upon an average, its weight (and ſpring together) are able to preſs up a pillar of quickſilver twenty-nine inches and an half high, or a pillar of water thirty-three feet high.

What we have now ſeen with regard to pumps, we may every day ſee practiſed in a ſmaller degree by the common ſyringe. If one of its ends be put into water, and the piſton be drawn up, this will make a ſpace void of air, and the water will be preſſed up into the void, and thus fill the ſyringe.

When children ſuck at the breaſt, it is by natural mechaniſm ſomewhat reſembling that of the ſyringe; for the child draws into its lungs the air in his mouth, then ſtops its entrance by the noſtrils, and next ſqueezes the nipple between

tween its lips, ſo that no air can come that way. Thus there is a void in the mouth, and the external air preſſing upon the mother's breaſt, ſqueezes the milk into the infant's mouth, and by this means it finds the nouriſhment proper for its ſupport.

Cupping-glaſſes may be explained upon the ſame principle. That part of the body under the mouth of the glaſs has no preſſure of air upon it; for the air was driven out of the glaſs by heat, before the glaſs was applied. The fleſh of the body is raiſed to that place where it finds leaſt reſiſtance.

The atmoſphere thus preſſing down upon the ſurface of the earth envelopes all the bodies upon its ſurface, and preſſes them together. The whole earth may be conſidered to ſuffer as great a preſſure from the atmoſphere, as if it were preſſed on every ſide by water thirty-three feet deep; and all that are upon the earth's ſurface are as much preſſed on every ſide as we would be, if inſtead of an airy atmoſphere we had an atmoſphere of water, like fiſhes, thirty-three feet above our heads. The weight of ſuch an atmoſphere of water can be eaſily calculated. A cubic foot of water we will ſuppoſe to weigh 60 pounds, 33 feet will weigh 33 times 60, that is 1980 pounds. Suppoſe a middle-ſized man has a ſurface of about 14 feet ſquare, he will ſuſtain 14 times 1980 pounds of water, that is 27,720 pounds.

pounds. If a man ſuſtains ſo much, who is but 14 feet ſquare, how much weight of atmoſphere will not the whole earth ſuſtain, which hath a ſurface of more than two millions of ſquare miles? Thus, whether the earth ſuſtains a weight of water thirty-three feet high, or an airy atmoſphere equal in weight, the difference is nothing, it will be equally preſſed by both. Thus, in the atmoſphere in which we move with ſo much freedom, and which we traverſe with ſo much rapidity, we are preſſed on all ſides with an almoſt incredible weight, and our bodies ſeldom ſupport leſs than twelve ton of air at a time.

So great a preſſure of air upon his body may well ſurpriſe the ignorant, and ſhake his belief; but he muſt conſider, that this weight of air he has carried from his earlieſt infancy. Senſations to which we have been always accuſtomed, are ſcarce felt: we cannot perceive the difference of things, when we have no ſtandard by which to meaſure their variations; we cannot perceive the weight of the air, becauſe we have always felt its weight, and cannot remove from its preſſure. No one part of the body can be diſturbed by its preſſure, for it lays the load equally upon all. Beſides this, there is a reſiſtance within the body, which ſerves to counterbalance that from without; and there is another conſideration alſo, which naturaliſts have paſſed over unnoticed. The heat of our bodies rarifies the air on their ſurface; ſo

that in fact an animal doth not ſuſtain ſo great a preſſure from the air as cold inanimate ſubſtances are found to ſuſtain. In ſhort, to uſe the words of Borelli, ſince by the air's preſſure none of the parts of our bodies can ſuffer either ſeparation, or luxation, or contuſion, nor any other change, it is impoſſible that this preſſure can produce any pain.

This preſſure then can do no injury to the animal frame, we find it by experience of infinite utility. By it the parts of our bodies are kept compactly together, by it the fluids in our veſſels are prevented from burſting their canals. Travellers, in aſcending high mountains, feel the want of this preſſure, to which they were accuſtomed in the valley: as they aſcend, they perceive a total laſſitude upon them from the dilatation of their veſſels, and at laſt the blood begins to burſt through the fine coats of the lungs, and they ſpit blood. It is probable that ſimilar effects are not unfrequently produced by this variation in the weight of the atmoſphere. Mead relates that Dr. Pitcairn, in the year 1787, being at his country ſeat near Edinburgh, in February, on a fairer day than uſual at that ſeaſon, was ſeized with a ſudden bleeding of the noſe after an uncommon faintneſs, and on the next day, on his return to town, he found that the *barometer* was *lower* at that very hour than either he or his friend Dr. Gregory, who kept a jour-

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nal of the weather, had ever obſerved it: and that another friend of his, Mr. Cockburn, profeſſor of philoſophy, had died ſuddenly at the ſame hour by an erruption of blood from the lungs; and alſo five or ſix others of his patients were ſeized with different hæmorrhages.

SECT. XII.

AIR SUPPORTS LIFE.

To ſhew "*that air is abſolutely neceſſary for the preſervation of life,*" many have been the animals that idle curioſity has tortured in the priſon of a receiver. We ſhall, from a thouſand inſtances, produce that of the *viper*, as it is known to be a reptile exceedingly tenacious of life, and as we ſhall feel but little compaſſion for its ſufferings.

Mr. Boyle took a new caught viper, and ſhutting it up in a ſmall receiver of an air-pump, he exhauſted the air. At firſt the reptile began to ſwell, it then moved up and down as if in queſt of air, and after a while foamed, leaving the foam ſticking to the ſides of the glaſs. It continued in this ſtate 23 hours, and appeared by its poſture, even after the lapſe of two hours, *lifeleſs*. But upon the air being admitted, the viper opened and cloſed its mouth, and continuing theſe alternate motions for a few ſeconds, it ſtill argued ſome remains of life. Other creatures, in the exhauſted receiver, much ſooner grow convulſed and die.

SECT. XIII.

THE AIR MUST BE RENEWED.

As *air* was ſhewn to be *abſolutely neceſſary for the continuance of life*, "*ſo is a due ſupply of it indiſpenſable.*"

The ſoubah, or viceroy of Bengal, dying in the month of April, in the year 1756, he was ſucceeded by his adopted ſon Sur Raja al Dowlah, a young man of the moſt violent paſſions, without faith, principle, or fortitude.

In the month of *May*, he cauſed the Engliſh factory at *Caſſimbuzar* to be inveſted, and invited Mr. Watts, the chief of the factory, to a conference; he detained him as a priſoner, and made himſelf maſter of the factory.

He then marched to *Calcutta*, and inveſted this ſettlement, which was in no poſture of defence. The *governor*, intimidated by the numbers and power of the enemy, abandoned the fort, and together with ſome of the principal perſons reſiding in the place, took refuge on board a ſhip in the river, carrying with them their moſt valuable effects.

The defence of the place then devolved to Mr. Holwell, the ſecond in command; who, with the aſſiſtance of a few gallant officers, and a very ſmall

garrifon, maintained the place with fingular courage and refolution, till at length, the enemy having forced their way into the caftle, he was obliged to furrender; the foubah having firft promifed him, on the honour of a foldier, "that no injury fhould be offered him or his garrifon."

Having made them prifoners, he ordered them, to the number of 146 perfons, to be put into a place called the *Black-hole* prifon, a cube of about 18 feet, open only to the weftward by *two windows* ftrongly barred with iron.

The humane reader will conceive, with horror, the miferable fituation to which they muft have been reduced, thus ftewed up, in a *clofe fultry night*, under the climate of Bengal, efpecially when he reflects that many were *grievoufly wounded*, and all of them *greatly fatigued* by the exertions of the preceding day.

A *profufe fweat* quickly broke out on every individual, attended with an *infatiable thirft*, which became the more intolerable as the body was drained of its moifture. It was in vain that they ftript off their clothes, or fanned themfelves with their hats.

A *difficulty in breathing* was next obferved, and every one *panted for breath*.

Mr. Holwell, who was placed at one of the windows, accofted the ferjeant of the guard, and endeavouring to excite his compaffion, he drew a pathetic picture of their fufferings, and promifed to gratify him in the morning with a thoufand rupees,

provided he could find means to remove ſome of his people into another place of confinement.

The Indian, allured by the promiſe of ſo mighty a reward, aſſured him he would uſe his utmoſt endeavour, and retired for that purpoſe.

What muſt have been the impatience at this time of theſe unhappy objects? — — — —
— — — — — — —
— — — — — — —
— — — — — — —

In a few minutes the jemmaudar returned, *but the tyrant*, by whoſe order alone ſuch a ſtep could be taken, *was aſleep, and no one durſt diſturb his repoſe!*

The deſpair of the priſoners now became outrageous. They endeavoured to force open the door, that they might ruſh on the ſwords of the monſters, by whom they were ſurrounded, and who derided their ſufferings; but all their efforts proved ineffectual. They then uſed execrations and abuſe to provoke the guard to fire upon them.

The jemmaudar was at length moved to compaſſion. He ordered his ſoldiers to bring ſome ſkins containing *water*, which, by enraging the appetite, only ſerved to increaſe the general agitation. There was no other way of conveying it through the two windows but by hats, and this mode of conveyance proved ineffectual, from the eagerneſs and tranſports of the wretched priſoners who ſtruggled for it in fits of delirium.

The cry of *Water! Water!* iſſued from every mouth.

The conſequence of this eagerneſs was, that very little fell to the lot even of thoſe who ſtood neareſt the window; and even theſe, who were eſteemed the moſt fortunate, inſtead of finding their thirſts aſſuaged, grew more impatient.

The confuſion ſoon became general and horrid; all was clamour and conteſt;- thoſe who were at a diſtance endeavoured to force their paſſage to the window, and the weak were preſſed down to the ground never to riſe again.

Mr. Holwell obſerving now his deareſt friends in the agonies of death, or dead, and inhumanly trampled on by the living, finding himſelf wedged up ſo cloſe as to be deprived of all motion, he begged, as the laſt mark of their regard, that they would for one moment remove the preſſure, and allow him to retire from the window, and die in quiet.

Even in ſuch dreadful circumſtances, which might be ſuppoſed to have levelled all diſtinctions, the poor delirious wretches manifeſted a reſpect for his rank and character: they forthwith gave way, and he forced his paſſage into the centre of the place, which was leſs crowded, becauſe, *by this time*, about one third of the number had periſhed, while the reſt ſtill preſſed to both the windows.

He retired to a platform at the further end of the room, and lying down upon ſome of his dead friends, recommended his ſoul to heaven.

Here

Here his *thirſt* grew inſupportable; his *difficulty in breathing* increaſed; and he was ſeized with a *ſtrong palpitation of the heart.*

Theſe violent ſymptoms, which he could not bear, urged him to make another effort: he forced his way back to the window, and cried aloud, "*Water, for God's ſake!*"

He had been ſuppoſed already dead by his wretched companions, but finding him ſtill alive, they exhibited another extraordinary proof of regard to his perſon: "*Give him water,*" they cried; nor would one of them attempt to touch it until *he* had drank! He now breathed more freely, and the palpitation ceaſed: but finding himſelf ſtill more thirſty after drinking, he abſtained from water, and moiſtened his mouth, from time to time, by ſucking the *perſpiration* * from his ſhirt ſleeves, which taſted ſoft, pleaſant, and refreſhing.

The miſerable priſoners now began to perceive it was *air* and not *water* that they wanted. They dropt faſt on all ſides, and a *pungent ſteam* aroſe from the bodies of the living and the dead, as *pungent* and *volatile* as *hartſhorn* †.

Mr. Holwell being weary of life, retired once more to the platform, and ſtretched himſelf by the Reverend Mr. Bellamy, who, together with his ſon,

* Does the acqueous perſpirable fluid contain *oxygen* in looſer bond of union than water?

† Did not the ſuperabundant *azot* unite with the *hydrogen* of the body, and form *volatile alkali?*

a young lieutenant, lay dead, locked in each other's arms.

In this ſituation he was ſoon deprived of ſenſe, and ſeemed to all appearance dead, when he was removed by his ſurviving friends to one of the windows, where the *freſh air* brought him back to life.

The ſoubah being at laſt informed that the greater part of the priſoners were *ſuffocated*, inquired if the chief was alive; and being anſwered in the affirmative, ſent an order for their immediate releaſe, when *no more than* 23 *ſurvived of* 146 who entered into this priſon alive *.

Another

* Mr. Holwell, and his ſurviving companions, were immediately after ſeized with a *putrid fever*, and in this condition dragged before the ſoubah to be queſtioned about a treaſure, which he believed they had ſecreted. This gentleman, having denied the empty aſſertion, was, with three of his friends, loaded with fetters, and conveyed near three miles to the Indian camp, where they lay a whole night expoſed to a ſevere rain. The next morning they were brought back to the town, chained and ſuffering the ſcorching rays of a ſun intenſely hot. Then large and painful petechiæ came out, and covered their whole body. In this piteous condition they were embarked in an open boat for the capital of Bengal, and underwent ſuch cruel treatment and miſery in their paſſage, as would ſhock the humane reader ſhould he peruſe the particulars. At length the ſoubah's mother interpoſed, and he replied, with an unexpected generoſity, "*their ſufferings have been great, and they ſhall have their liberty.*"

This fact throws a great light upon the origin of *putrid fever*.—The great and good Dr. Hales, whoſe ſtudies and experiments

Another melancholy proof of the *necessity of a due supply of air*, may be drawn from the testimony of Dr. Trotter, delivered before a select committee of the *House of Commons*, in the year 1790.

In July 1783, the slave-ship, in which he was, arrived at Cape *La How*, on the Gold Coast of *Africa*. In the space of a week above *one hundred* prime slaves *, *young*, *stout*, and *healthy*, were purchased

periments were constantly directed to the benefit of mankind, recommended a trial of *ventilators* in the *Savoy* and *Newgate* prisons, in both of which the *jail fever* was frequent, and commonly fatal: the good effects exceeded even his most sanguine expectations; for a very small portion of the sick died, when the ventilators came into use, and the contagion seemed in a manner arrested. The benevolent Mr. Howard found the prisons on the continent perfectly free from *this pestilential fever*; owing, as he thinks, to the apartments in which the prisoners were confined being spacious, and consequently well aired.

* THE MODE OF OBTAINING SLAVES.—Dr. Trotter says, that the natives of these parts are *sometimes* slaves from *crimes*, but the greater part of the slaves are, *what are called prisoners of war*. Of his whole cargo he recollects only *three criminals*; two sold for *adultery*, and one for *witchcraft*, whose *whole family shared his fate*. One of the first said he had been decoyed by a woman who had told her husband, and he was sentenced to *pay a slave*; but being *poor*, was *sold himself*. The last said he had had a quarrel with a *caboshieer* (or great man), who *in revenge* accused him of *witchcraft*, and sold *him* and his *family for slaves*.

Dr. Trotter having often asked Accra, a principal trader at La How, what he meant by *prisoners of war*, found they were such as were carried off by a set of *trepanners and kidnappers, who ravage the country for that purpose*. The bush-men making war, *to make trade* (that is, *to make slaves*), was a common

chased. The competition, however, of the purchasers at *Annamaboe*, whither this ship afterwards sailed, ran so high, that the captain could not obtain more than two thirds of the usual complement. The slaves were confined below sixteen hours out of twenty-four, and permitted no exercise when upon deck. The rooms, where they were secured, are from five to six feet in height. These rooms are imperfectly aired by gratings above, and small scuttles in the side of the ship, which of course can be of little use at sea. The gratings are also half covered, when it blows hard, to keep out the salt spray. The temperature of these rooms was often

mon way of speaking among the traders. Having asked, What they did with their slaves when the nations, who traded for slaves with them, were at war with each other? was answered, That when ships ceased to come, *slaves ceased to be taken*. The practice was also confirmed by the slaves on board, who shewed by gestures how the *robbers* had come upon them.

He once saw a black trader send his canoe to take *three fishermen* employed in the offing, who were immediately brought on board, and put in irons, and about a week afterwards he was paid for them. He remembers another man taken in the same way from on board a canoe along-side. The same trader very frequently sent slaves on board in *the night*, which, from their own information, he found, were *every one of them* taken in the neighbourhood of *Annamaboe* He remarked, that slaves sent off in the *night*, were not paid for till they had been some time on board, lest, he thinks, they should be *claimed*; for *some were really restored*, one in particular, a boy, was demanded and carried off on shore by some near relations, which boy told him, he had lived in the neighbourhood of *Annamaboe*, and was *kidnapped*.

above

above 96 of Farenheit's ſcale. In the evidence, of which this is an abſtract, Dr. Trotter affirms, he could never breathe there, unleſs under the hatchways. In ſuch circumſtances the ſufferings of theſe poor creatures muſt have been dreadful. *I have often*, ſays Dr. Trotter, *obſerved the ſlaves drawing their breath with all the laborious and anxious efforts for life, which are obſerved in expiring animals, ſubjected by experiment to foul air, or in the exhauſted receiver of an air-pump. I have often ſeen them, when the tarpawlings have been inadvertently thrown over the gratings, attempting to heave them up, crying out in their own language*, "We are ſuffocated." *Many have I ſeen dead, who the night before have ſhewn no ſigns of the ſmalleſt indiſpoſition; ſome alſo in a dying ſtate, and if not brought up quickly upon the deck, irrecoverably loſt.*

Hence, before the arrival of this veſſel at *Antigua*, out of 650 ſlaves more than 50 had *died*, and about 300 were tainted with the *ſea ſcurvy* *.

Mr.

* This fact throws a great light on the *origin* and *nature* of *ſea ſcurvy*, as will be ſhewn hereafter when treating on that diſeaſe. —In our unfortunate expedition to *Quiberon* there were an hundred picked horſes put on board a tender. A ſtorm coming on, the hatchways were cloſed, and theſe animals remained in this dreadful ſtate above eight-and-forty-hours. Ten were found ſuffocated, and ſixty *glandered*, and communicated the diſeaſe to other horſes when they landed. So ſudden and general an infection, Mr. Coleman, the Veterinary Profeſſor, thinks could not have happened from the ſuppoſition that a glandered

Mr. Wilſon ſtates, that in his ſhip, and three others belonging to the ſame concern, they purchaſed among them 2064 ſlaves, and *loſt* 586. He adds, that he has known ſome ſhips in the ſlave trade bury a *quarter*, ſome *a third*, and others even *half* of their cargo *.

To mention no other fact, a ſtrong proof of *the neceſſity of a frequent renewal of the air*, may be found in the Records of the *Dublin Lying-in Hoſpital*.

In this hoſpital 2944 infants out of 7650 died in the years 1782, 1783, 1784, and 1785, within the firſt fortnight after their birth, that is, nearly *one child*

glandered horſe, by ſome overſight, had been ſhipt along with the reſt, as it requires a week before this diſorder could have infected others (as in the ſmall-pox, &c.), and attributes the origin of *glanders*, in this inſtance, ſolely from the ſtived ſituation in which theſe poor animals were placed.

* Even on the preſent regulated plan the ſituation of the ſlaves muſt be dreadful; for their bodies touch each other, and many of them have not room to ſit *upright*.

Ye bands of Senators! whoſe ſuffrage ſways
Britannia's realms, whom either *Ind* obeys;
Who right the injured, and reward the brave,
Stretch your ſtrong arm, for *ye have power to ſave!*
Throned in the vaulted heart, his dread reſort,
Inexorable conſcience holds his court;
With ſtill ſmall voice the plots of guilt alarms,
Bares his maſked brow, his lifted hand diſarms;
But, wrapt in night with *terrors* all his own,
He ſpeaks in thunder when the deed is done.
Hear him, ye ſenates! Hear *this truth* ſublime,
He, who allows oppreſſion, ſhares the crime.

Dr Darwin.

out

out of every *ſix*. They almoſt all died in convulſions, of what the nurſes called *nine-days fits*, becauſe they came on within nine days after their birth. Theſe children, many of them, foamed at their mouths, their thumbs were drawn into the palms of their hands, the jaws were locked, the face was ſwelled and looked *blue*, as *though they were choaked.*

This laſt circumſtance led Dr. Clark to conclude that the rooms in the hoſpital were too *cloſe* and *crowded*, and hence the infants had not a ſufficient ſupply of *good air* to breathe. This benevolent phyſician contrived, therefore, *air-pipes*, 6 inches wide, which were placed in the ceiling of each room. Three holes, an inch wide, were bored through each window frame; and a number of holes were made in the doors at the bottom.

By theſe contrivances the rooms were kept *ſweet* and *freſh*; and the *conſequence* has been, from the regiſter in that hoſpital, that,

	Children.	
In 1786, out of	1372 there died	51
1787, ——	1375 ——	59
1788, ——	1496 ——	55
	4243	165

Now if out of 4243 children there periſh, *when the hoſpital was ventilated*, only 165 infants, how many

many may be expected to die out of 7650, the number of children born in the *Dublin Lying-in-Hospital* in the years 1782, 1783, 1784, and 1785?

The answer is, by the rule of proportion,—279. But how dreadful the account, there *died* absolutely 2944, that is 2665 solely *from the want of a due supply of air!*—and we have not only to deplore the number of innocent victims, who were destroyed in these few years and previous to them, but also to lament the wretched anguish of the disconsolate parents, and the impoverished state of health in many of the poor babes who survived this great slaughter.

SECT. XIV.

WHY THE AIR MUST BE RENEWED.

HAVING proved the connexion betwixt *life* and *air*, it is neceſſary now to ſhew *what are the chemical alterations air undergoes by being reſpired.*

Dr. Prieſtley having formed *nitrous air* by the ſolution of various metallic bodies in *nitrous acid*, he diſcovered that it poſſeſſes this ſingular property, that when mixed with *common air*, a great *diminution* of the bulk of the 2 *aerial fluids* takes place, attended with a turbid red, or deep orange colour, and a conſiderable heat.

I hardly know, ſays this philoſopher, any experiment, that is more adapted to amaze than this, which exhibits a quantity of *air*, which, as it were, devours a quantity of *another kind of air*, half as large as itſelf, and yet, inſtead of acquiring *larger dimenſions*, becomes itſelf *conſiderably contracted.*

We are not ſo much ſurpriſed when we find an *aeriform body* ſtarting out from a *ſolid ſubſtance*, as in the formation of *nitrous* and *other factitious airs*; but we are more ſenſibly affected, when, on the reverſe, *two inviſible aerial bodies* are converted into a *compact coloured fluid*; for, like condenſed ſteam, they occupy, in *compariſon* with their former dimenſions,

ſcarcely any perceptible *ſpace*. Here the *nitrous air* attracts to itſelf *oxygen*, the baſe of vital air, *caloric* is given out, and *this combination* gives us *nitrous acid*.

This diſcovery * was a moſt agreeable one to me, adds this great experimentaliſt, as I hope it may be an *uſeful one* to the public. It is remarkable that *this air* occaſions no efferveſcence or *diminution* with *fixed* or *inflammable airs*, but only with *air fit for reſpiration and combuſtion*, and, as far as I can judge, *exactly in proportion* to *its fitneſs for that purpoſe* †; ſo that by this means the *goodneſs* of any air may be diſtinguiſhed much more accurately, than by putting into it a mouſe, or any other animal, to try how long it can exiſt in any given quantity. By *this teſt* I was enabled to perceive a *real difference* in the air of my *ſtudy*, after a few perſons had been with me in it, and the air on the *outſide of my houſe*. A phial of air being ſent me from the neighbourhood of *York*, it appeared to be not *ſo good* as the air near *Leeds*; that is, it was not *diminiſhed ſo much* by an *equal* mixture of *nitrous air*.

The juſtly celebrated chemiſt *Lavoiſier*, aſcertains

* This fact was known to Mayow, but practically employed as a teſt of goodneſs of air *firſt* by Dr. Prieſtley.

† That is, in proportion to the quantity of *oxygen air* it contains, which will preſently appear to be the *pabulum vitæ*, or *principle of life*. It was ſhewn in the former part of this work, that *atmoſpheric air* is a compound of *two diſtinct* and *ſolid ſubſtances*, *oxygen* and *azot*, rendered *aerial*, by the ſuſpenſive power of *caloric*, *fire*.

the proportion of *vital air* * contained in any given quantity of *common air* by the means of *phosphorus*. His *eudiometer* is thus constructed. Having filled a cylindrical glass tube with quicksilver, he immerses it in a bason of the same fluid. He then puts into it *the air*, the purity of which he proposes to examine. He afterwards passes up the *phosphorus*, and having heated an iron wire at the extremity red hot, he applies the hot end to the *phosphorus* through the quicksilver, which quickly consumes †, and the quicksilver *rises* nearly 27 divisions (if the tube has been accurately divided into 100 parts ‡); after

* The reader has already learnt, from the discoveries of Lavoisier, that *atmospheric air* consists of *two parts*, viz. *oxygen air*, blended with *azotic air*, which by chemical means may be separated, and confined in different jars, and that a mouse, or any other animal, will live a considerable time in the *one*, being lively, brisk, and active; whilst, in *the other*, he soon languishes and dies. *This part* of the air, therefore, as so much contributing to *life*, is with the utmost propriety denominated by physicians, VITAL AIR.

† *Phosphorus*, like other combustible bodies, attracts *oxygen*, the particles being once separated beyond their sphere of mutual attraction, or *the attraction of cohesion*. The *caloric*, which is disengaged from the *attracted oxygen*, answers the same purpose as the *hot iron* which first kindled the *phosphorus*. The *phosphorus* becomes in consequence of this union with *oxygen*, *phosphoric acid*.

‡ In 100 parts of atmospheric air, there is most commonly found 27 of *oxygen air*; or, in other words, in 100 *gallons* of *air*, there would be found 27 *gallons* of *oxygen air*, and 73 of *azotic air*.

 which

which time, if any *phosphorus* remains, it ceases to burn, there being no more *oxygen* in the tube to be attracted by the *phosphorus* *.

By *this means Lavoisier* ascertained, that when the *air out of doors* consisted of

27 parts *oxygen air*,
and 73 —— *azotic air*,

100 parts;

The air in the lowest ward in the *General Hospital* at *Paris, contained*

but 25 parts of *oxygen air*,
and 71 —— of *azotic air*,
and 4 —— of *fixed air*,

100 parts.

This proportion varied in different parts of the same room. At the *top* the air had suffered much more injury. It contained

but 18½ parts of *oxygen air*,
and 79 —— of *azotic air*,

* This clearly evinces that *combustion* is the divorcement of *oxygen* from *caloric*, *which being set at liberty*, assumes, as it is escaping the character of *flame* or *fire*, for the *phosphorus* no longer burns, than while *oxygen air* is present, and the *phosphoric acid* will have an *increase of weight* exactly corresponding to the *weight* of *oxygen air consumed*; that is, 100 parts of *phosphorus* will absorb 154 parts of *oxygen* or base of *vital air*.

and

and $2\frac{1}{2}$ —— of *fixed air*,

100 parts.

And when, before the play, the *air* in the *theatre* in the Thulieries contained

27 parts of *oxygen air*,
and 73 —— of *azotic air*,

100 parts;

Towards the conclusion of the piece, which was acted before an unusual concourse of spectators, it contained

but 21 parts of *oxygen air*,
and $76\frac{1}{2}$ —— of *azotic air*,
and $2\frac{1}{2}$ —— of *fixed air*,

100 parts.

Whence it is evident, that the *quantity* of *oxygen*, or *vital*, *air* had been diminished in the theatre in the proportion of 27 to 21, or nearly *one fourth*; that is, it was *one fourth less fit for respiration than before*.

The air of the atmosphere, therefore, which is originally composed of 2 *fluids*, is composed of 3 *aerial fluids*, in all places which contain numerous assemblies of people. *These 3 aerial bodies*, though blended together, arrange themselves in some degree according to their specific gravities; that is,

 the

the proportion of *azotic air*, which is the lighter body of the three, will be found moſt in the *upper part*, the *oxygen air* in the middle, and the *fixed air* will be found moſt in the *lower part* of the apartment.

This occaſions a circulation in the air, for, in ſpite of the architect, the *rarefied air* will aſcend, the *fixed air* ſink, and the *colder* and *purer air* ruſh into the apartment through every crevice *.

Unleſs

* To render the *circulation* of the air *ſenſible*; if the air of a room be *heated* by fire in it, whilſt the air in a contiguous room is *cold*; then let the door between theſe two rooms be opened, in which caſe the *hot air* of one room being *rarefied* will paſs through the *upper part* of the opening of the door into the cold room; and on the contrary the *cold air* of the other room being *heavier*, will paſs into the former through the *lower parts* of the opening. This may be proved by applying a candle at the *top* and *lower parts* of the opening between the two rooms. The direction of the flame of the candle will point out the *contrary currents of air*. It is for this reaſon that when a fire is lighted in a chimney, a *ſtrong current of air* enters the room, which may be felt by applying the hand near the key-hole, or other ſmall openings, if the doors and windows be ſhut. It is in this way that a fire is ſaid to purify a room: but this effect is only becauſe the fire promotes the *circulation* of the air, and dries the dampneſs of the apartment: ſo that it is not the infected air that is purified, but a *new, freſh*, and *wholeſome air*, by the action of fire, that is made to take place of a bad and corrupt air. Hence it appears, that thoſe perſons are miſtaken who are over-anxious in keeping out the air from entering the apartments of convaleſcent perſons,

Unless *this were the case*, and unless *the air was constantly renewed*, the spectators would be exposed to the most fatal accidents long before the conclusion of the performance.

To convince ourselves of this truth, nothing more is necessary than to take the example of a room, let it be supposed 30 feet long by 25, and 30 feet high.

A room of these dimensions would contain 100 spectators. Now since each person consumes about 5 cubic feet of air in an hour, that is, deprives such a quantity of air of its oxygen air or *vital principle*, it

sons, by *accurately stopping, by list, linings*, and *sand-bags, all the smallest openings that admit fresh air*.

I cannot forbear mentioning here, as it relates to health, the method for preventing *smoky chimneys*. The particles of air, which are expanded by the fire, being lighter than those particles which are not heated, just as a cork rises, if placed at the bottom of a tub of water, so must the *rarefied air* ascend and pass up the chimney, as being the lighter body of the two. If we conceive the figure of a *French horn*, it is evident that *the volume of air* contained *in the mouth-piece*, would be *sooner heated* than *that at the base*, and therefore the *rarefaction of air* be more certain, were any given quantity of heat applied to the *smaller* than the *larger portion of air*. It is thus with chimneys, the more they resemble the *French horn*, the more certain the ascent of the smoke, for the *smaller* the *portion of air* at the bottom, the *sooner* will it be heated, and the *balance* at the *lower* and *upper parts* of the chimney being destroyed, the *lighter air* cannot but ascend and carry with it the smoke. —The *aperture* at the *bottom* of chimneys should, therefore, be *small*; and by contracting the chimney-corners also, a greater heat is thrown out into the room.

would follow, that as ſuch a room could contain only 22,500 cubic feet of air, that unleſs the air was conſtantly renewed it would be rendered completely mephitic or noxious in about *four hours and an half*, and it is probable that the greater part of the audience would be ſeriouſly incommoded, or even periſh, long before the end of that period *.

The ſame calculation applies to all confined places, where a number of perſons are aſſembled together: eſpecially if the air circulates in them ſlowly, or with difficulty: *the oftener it is reſpired the more it will become vitiated*; and it is eaſy to obſerve how the attention of the audience fails them in ſuch places. They can no longer liſten to the diſcourſe. The irritating quality of the mephitic air excites a general coughing. The preacher now receives none of thoſe marks of attention or reſpect, which in more favourable circumſtances he had a right to expect. They experience a drowſy headach. They expreſs even a phyſical anxiety to be gone, and the congregation feel themſelves on returning home jaded, and till revived by a *more wholeſome or oxygenated air* they look wan, like perſons who are ready to faint away.

We now ſee the reaſon why Dr. Thornton, in a letter to Dr. Beddoes, the celebrated Profeſſor of

* The affecting narrative of the *Black-hole* of *Calcutta*, and the *Dublin Lying-in-Hoſpital*, are melancholy confirmations of the truth of this ſuppoſition of Lavoiſier.

Chemiſtry

Chemiſtry at Oxford, and inſtitutor of the *Pneumatic Practice*, ſays, that he is perſuaded *oxygen gas* would be found of great ſervice, if diffuſed at certain ſeaſons, in *mines*, in *churches*, in *crowded rooms* *, in

* A lively young lady, who came to *Bath*, to put herſelf under the care of Dr. Makittrick Adair, gave a rout, and inſiſted that he ſhould be of the party. The room was *ſmall*, and the company very *numerous*. He had not been long ſeated at the card-table, before a young gentleman, his partner, *fell into a ſwoon*. The doors were immediately thrown open to afford him freſh air, and the ſaſh lifted up, and both the gentleman who ſwooned, and the young lady, Dr. Adair's patient, who were invalids, were much injured by the ſudden expoſure to a current of cold air. How the reſt of the company were affected, ſays Dr. Adair, I had not an opportunity of knowing; but my own feelings and ſufferings for many hours after I retired from *this oven*, convinced me of the *dangerous conſequences* of *ſuch meetings*. On declaring a few days after, to one of my brethren, a man of humour, my reſolution of writing a bitter philippic againſt routs, he archly replied, "Let them "alone, Doctor, how otherwiſe ſhould *twenty-ſix* phyſicians "ſubſiſt in this place!"

If a ſmall tube, opening into the apartment deſigned for *routs*, was to communicate with the outward air, the external orifice of the tube being made *ſomewhat above the level of the room*, the fire and breath of the aſſembly would have no ſooner heated the air, than it would riſe immediately *upwards*, ſo as to fill more particularly the higher parts of the room; and, as other particles would be ſucceſſively heated and rarefied in their turn, by their expanſive force they would preſs upon the upper ſtatum of air, ſo as to force the *lighteſt particles* through the opening left for that purpoſe in the ceiling of the room, by which contrivance the *foul and hot air* of the apartment would be *gradually drawn off*, and a wholeſomer atmoſphere left in the room.

But

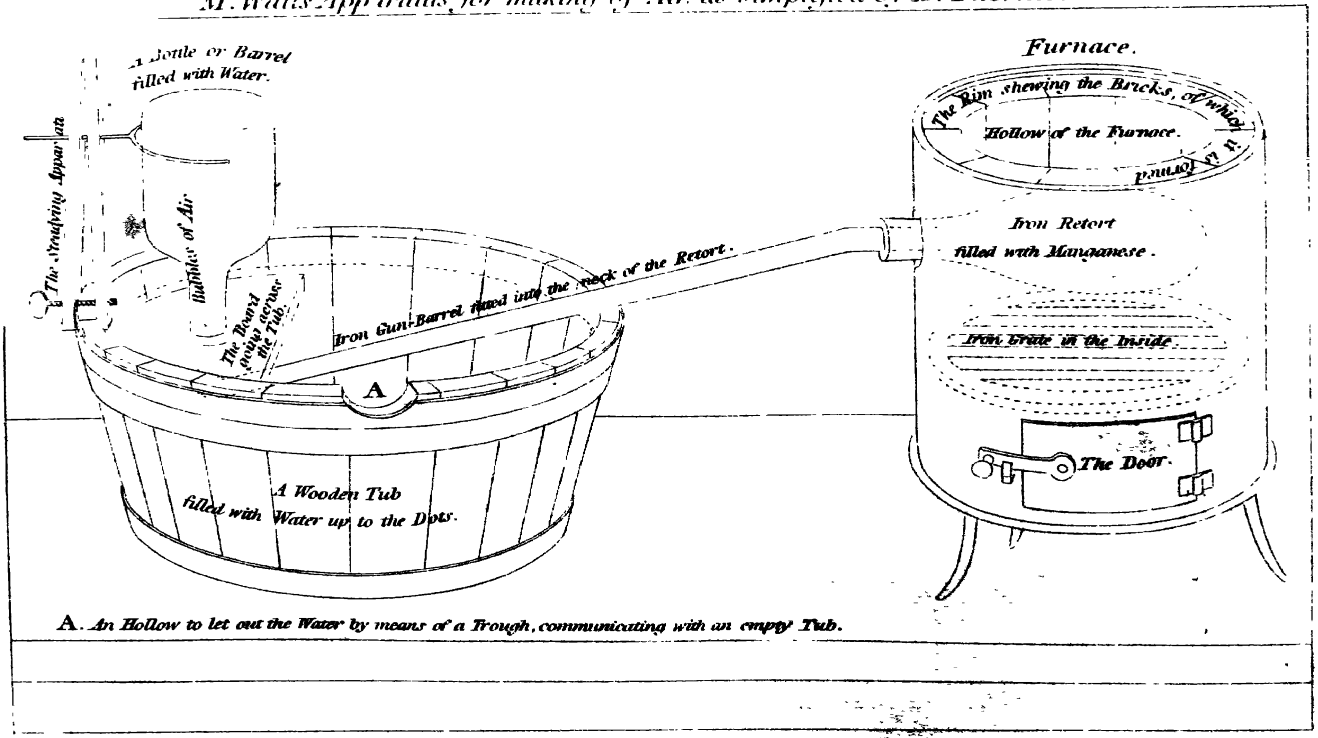
in the *chambers* of the sick, in *hospitals*, and other *public buildings*, and especially in the *bathing-rooms* at Bath, where great *faintness* is often brought on the patients who are bathing by breathing a *reduced atmosphere* from the extrication of *azotic air*, which is given out in a considerable quantity by those waters *.

But in order *to admit fresh air* into the drawing-room, if another opening be made in the ceiling of the room, having a communication with a small pipe that should lead from thence to the outside of the house, and extend *some way beneath the level of the room*: in this situation the *cool external air* would be forced in at the lower opening of the tube, and ascend into the apartment in proportion to the quantity that escaped from the upper region by means of the other tube, and since weighty air would no sooner enter the room than it would tend downwards by its own natural gravity, it would gradually be heated by the warm air in its descent, and would thus be dispersed about the room, so as *mildly* and *imperceptibly* to reach the company and supply them with a sufficient quantity of fresh and vivifying air, without any [illegible] those inconveniencies to which the company are subjected [illegible] usual way of admitting *fresh air*. This simple [illegible] might be made [illegible] as *elegant* as it must be *beneficial*.

The expence and trouble of diffusing *oxygen air* is at present an objection, but let us reflect that in every hundred weight of *minium* or *red lead*, there is combined about six *pounds* weight of *oxygen*, or *pure air*. Now as 60 pounds of water are about a cubic foot, and as oxygen air is eight hundred times lighter than water, 500 weight of *minium* or *red lead* should produce 800 *cubic feet of oxygen air*, or about 6000 *gallons*. And, since the substances, which contain *oxygen*, or *vital, air*, in immense quantities are of little value, we have a right to expect, that a perfect, salubrious, *pure air*, may, as

 chemistry

Mr. Watt's Apparatus for making of Air as simplified by Dr. Thornton.



A. An Hollow to let out the Water by means of a Trough, communicating with an empty Tub.

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chemiſtry advances, be obtained from ſuch materials by a *cheap* and *eaſy proceſs*.—Dr. Darwin

It has been computed by the Abbé Fontana, that a pound of *nitre*, calcined in a cloſe veſſel, yields 12,000 cubic inches of VITAL AIR. It is ſingularly curious that a ſubſtance of ſuch very humble pretenſions as common *nitre* (ſalt-petre) ſhould poſſeſs properties on which hangs the fate of the moſt powerful empires! Since by chemiſtry it may either be converted into a fulminating engine, to overturn fortified cities, and to enable the garriſon to launch out death and deſtruction on the beſiegers: Or,—that by a different proceſs, it may be made to pour forth VITAL AIR, that *vivifying fluid* diffuſed through the atmoſphere, which breathes in the zephyrs, which whiſpers in the breeze, and which cheers and ſupports all animated Nature!

How many thouſand tons of *nitre* has Europe conſumed of late, in making gunpowder, and that with the avowed intention of *deſtroying* thouſands of its inhabitants! Might not a ſmall portion be ſpared for another purpoſe, at leaſt equally humane and laudable, viz. that of *preſerving* an unfortunate fellow creature! Should *the preſent* advanced price of *nitre*, however, render the preparation of VITAL AIR too expenſive a *remedy*, the latter may be obtained by a ſimilar proceſs from *mangan(e)ſe*. Beſides, the VITAL AIR from *mangan(e)ſe* has been lately diſcovered to be of ſuperior quality, and in greater abundance; a circumſtance of no *ſmall importance*, now that the demand for VITAL AIR, on account of *medicinal purpoſes*, is daily increaſing; nor is that to be wondered at, ſince the new light which it continues to reflect on the *œconomy*, has already began to dawn on the *pathology*, a circumſtance which ſeems to denote, that a very material REVOLUTION in the practice of phyſic is at no great diſtance.—From Dr. Fothergill's admirable Eſſay, *On the Suſpenſion of Vital Action*, to which was adjudged, by the *Medical Society* of London, the *prize* of a *gold medal*.

SECT.

SECT. XV.

THE CHEMICAL ALTERATION AIR UNDERGOES BY BEING RESPIRED.

It was ſhewn in the laſt ſection, that if an animal be confined under a bell-glaſs, where all admiſſion of freſh air be denied, the air which before conſiſted of 2 *aerial fluids*, viz.

1. *oxygen air*,
and 2. *azotic air*,

will preſently conſiſt of 3 *aerial fluids* ;

1. *oxygen air, in a diminiſhed quantity*,
2. *azotic air*,
and 3. *fixed air*.

At length the *oxygen air* being conſumed, the animal will ceaſe to live, and the air in the bell-glaſs will be found to conſiſt now of 2 *aerial fluids* only, that cannot maintain life, viz.

1. *azotic air*,
and 2 *fixed air*.

A queſtion naturally ariſes, *what has become of the oxygen, or vital, air*, deprived of which an animal *dies?*

OFFICE

OFFICE OF THE LUNGS.

In the lungs the blood coming into contact with *atmofpheric air* * works many chemical alterations in it.

Here it is (in the cells of the lungs) that the dark blood, throwing off attenuated *carbon*, forms with the VITAL AIR of the atmofphere,—*fixed air* †:

* "*Refpiration* we cannot explain: we only know," fays Dr. Hunter, in his Introductory Lecture which he publifhed in the year 1784, "that it is, *in fact*, effential and neceffary "to life. Notwithftanding this, when we fee all the other "parts of the body, and their functions, fo well accounted "for, we cannot doubt but that *refpiration* is fo likewife. "And IF EVER we fhould be happy enough to find out "clearly the object of this function, we fhall, doubtlefs, as "clearly fee, that *this organ* is as wifely contrived for *an important office*, as we now fee the purpofe and importance of "the *heart*, and vafcular fyftem; which, till the circulation "of the blood was difcovered, was wholly concealed from us." If this learned teacher was to rife from the grave, I believe, no fubject would give him higher delight than to behold, iffuing from the furnaces of the chemift, a new and fimple philofophy, which has clearly developed the *nature* and *neceffity* of *refpiration*.

† This is proved by making an expiration through a tube containing *lime-water*, which will become inftantly *turbid*.— Or if black blood be confined in a phial containing *vital air*, the whole of *that air* will be converted into *fixed air*.

Here

Here it is, that the purple blood parts with its *hydrogen*, which, uniting with the VITAL AIR, forms — the *humid vapour* that iſſues from the mouth *.

And here it is, that the *dark blood* (having thrown off *hydrogen* and *carbon)* *imbibes* the VITAL AIR, which changes its *purple colour* to a *brilliant red.*

I. E :IMENTS TO PROVE THAT PURPLE VENAL BLOOD ABSORBS OXYGEN AIR.

blood be taken from a *vein*, it readily ſeparates into 2 parts, a thin ſemi-tranſparent fluid called *ſerum*, and the *craſſamentum*, floating on it.

This firm ſubſtance at firſt appears of a *dark purple colour inclining to black*, but ſoon it aſſumes on *its upper ſurface a bright ſcarlet appearance*, reſembling the blood contained within *an artery*.

To prove that *this florid colour* is owing to the abſorption of *oxygen air* (one of the principles of *common air)*, the illuſtrious Dr. Goodwin encloſed a quantity of *vital air* in a glaſs receiver inverted over quickſilver, and introduced into it 4 ounces

* This you may prove by placing venal blood in *vital air*, when the ſides of the veſſel will be covered with large drops of *water*.—Or if black blood be received into a phial containing *azotic air*, *ammoniac* will be formed, which was ſhewn by Bertholet to be nothing more than *hydrogen* combined with *azot*.

of

Three small portions of the Lungs.

The air cells of the Lungs;
Fig. 1

These cells magnified.
Fig. 2

Fig.

Fig. 1.2 *Shew the air cells of the Lungs at the moment of Inspiration, when the blood in the minute vessels covering of air-cells, has Imbibed the* Vital Air, *and thrown off* Carbon & Hydrogen

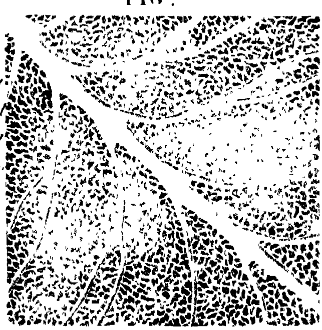

Fig. 3. *Shews the air-cells a few moments after Expiration, when a new & dark column of blood pervades the air-cells replete with* Carbon Hydrogen, *and devoid of* Vital Air.

of blood freſh drawn from the *jugular vein* of a ſheep: the blood became inſtantly *very florid*, and the quickſilver ſeemed to *aſcend* a little in the receiver. To aſcertain this latter circumſtance, I repeated, ſays he, the experiment three or four times; *the change of colour* in the blood was always *very ſudden*, and after ſeveral minutes the quickſilver *aſcended* two or three lines.

If *oil* be ſpread on the ſurface of the blood will prevent the contact of air, no ſuch altera to colour takes place.

Girtanner, who turned his thoughts much this ſubject, diſcovered that *venal blood* not only aſſumed a *bright vermilion colour* when expoſed to *oxygen air*, but gave out *carbon* and *hydrogen*, which uniting with the *oxygen air*, formed *fixed air* * and *water* †, which was found on the ſurface of the quickſilver.

* *Charcoal* and *oxygen air*.

The preſence of *fixed air* is aſcertained by *lime water*; for water diſſolves *lime*, and holds it ſuſpended. The ſolution then appears perfectly clear and bright. If any *fixed air* comes into contact with the water, the *carbonic acid* ſeizes on the *lime*, and makes with it a combination *inſoluble* in *water*. The *lime*, in that caſe, is *viſible* in the water. *Lime water* is therefore a teſt of the preſence of *fixed* or *carbonic acid air*.

† *Hydrogen* and *oxygen*.

II. EX-

II. EXPERIMENTS TO PROVE THAT CRIMSON ARTERIAL BLOOD CONTAINS OXYGEN AIR.

The *arterial blood* from the carotid artery of a ſheep was received into a bottle full of *azotic air*. The blood from a *bright red* ſhortly aſſumed the *deep colour of venal blood*. On opening the bottle the next day, the *azotic air* which it before contained was found mixed with *oxygen air*, ſo that an animal could live in it, and a candle burnt in it for near two minutes.

This experiment proves deciſively that *arterial blood* contains *oxygen air*, and that as ſoon as it parts with *this air* it then reaſſumes the true *venal character*.

The *arterial blood* of the carotid artery of a ſheep was received into a bottle full of *nitrous air*. The blood aſſumed a *green* colour * upon the ſurface. A ſmall quantity of greeniſh ſerum was ſeparated. The day after, on opening the bottle, the vapour of *nitrous acid* was obſerved by all who were preſent.

* Dr. Girtanner having injected ſome *nitrous air* into the *vein* of a dog, when it came into contact with the common air admitted into the lungs, *nitrous acid* was formed, and the lungs aſſumed in conſequence a *greeniſh hue*. The blood returned by the veins to the heart was found *black*.

Here

Here then is an experiment which alſo proves *the preſence* of *oxygen air* in the *arterial blood*; ſince it is from this circumſtance alone that it is capable of changing *nitrous air* into *nitrous acid* *.

III. DR. GOODWIN'S CELEBRATED EXPERIMENTS.

But that no poſſible doubt might exiſt, that *oxygen air* is imbibed *by the blood* in *the lungs*, Dr. Goodwin opened the cheſt of a living dog.

The LUNGS and HEART were then expoſed to view.

The blood, which was driven from the *right ventricle* of the heart into the *pulmonary artery* †, appeared of a *dark venous complexion.*

It certainly was a ſtriking ſpectacle to obſerve the *black blood*, as it returned from the lungs by the four *pulmonary veins* ‡ of the *lungs*, in its paſſage to the *left auricle* of the heart, appear of a *bright vermilion colour*.

It was ſoon found neceſſary to inflate the lungs by artificial means.

If at any time this was intermitted, the blood in the four *pulmonary veins* appeared of a *dark purple colour*, and the *left diviſion* of the heart receiving *black blood*, a *diminution* of the pulſations of the *heart*.

* Vide Sect. XIV. An account of Dr. *Prieſtley's* forming of Nitrous Air.

† Vide Map of the Heart, figure (5).

‡ Vide Map of the Heart, figures (8), (9), (10), (11).

and *arteries* took place, and in a little time all *their actions* ceafed.

But if at this time the *lungs* were made by the *inflation* of common air alternately to collapfe and diftend, the blood in the *pulmonary veffels* regained its former *crimfon colour*, and *the action* of the *heart* and *arteries* was *excited anew* *.

Thus, if we open the breaft of a frog, and ftop the trachea, or windpipe, we obferve, firft, its pulmonic blood *florid*, and the heart beating ftrongly; fecondly, fome time after, the pulmonic blood has become of a *dark colour*, and the heart's motion has grown languid; after this, the pulmonic blood becomes *black*, and the pulfation of the heart ceafes; and, laftly, the trachea of the frog being untied, and the creature allowed to breathe again, the blood becomes *crimfon*, and the heart acts with its priftine vigour.

* A fimilar experiment to this was performed by the illuftrious Hook before the Royal Society an hundred years ago, when an animal, whofe heart was expofed to view, was kept alive a whole hour by the inflation of its lungs. When this was omitted, the heart began to beat flower, and foon ceafed all action, the eyes funk, and the animal became convulfed; but all thefe fymptoms difappeared as foon as the lungs became again inflated with air. An experiment of the fame kind is alfo related by the illuftrious John Hunter, which fhewed moft evidently the connexion of refpiration with the *colour* of the blood and action of the heart. Vide Hunter on Sufpended Animation.

SECT. XVI.

THE CIRCULATION OF THE BLOOD

The immortal Harvey, the pride of our country, was the diſcoverer of the circulation of the blood. Seeing, ſays he, that the blood paſſed from the arteries in abundance into the veins, unleſs theſe were to empty themſelves, and the others to be refilled, that ruptures of veſſels every where would take place, which does not happen, I began to conjecture, there muſt be a circular motion of the blood; but this doctrine was ſo *new* and *unheard of*, that I feared much detriment might ariſe from the envy of ſome, and that a number would take part againſt me, ſo much does cuſtom and doctrine once received, and deeply rooted, pervert the judgment. However, my reſolution was bent to ſet this doctrine forth, truſting in the candour of thoſe who love and ſearch after truth. In a letter to profeſſor Riolan this great man ſays, Since the publication of the circulation of the blood, almoſt no day has paſſed in which I have not heard both good and evil of my doctrine. Some ſay that this babe of mine is worthy to be foſtered; and that I have by many obſervations, and ocular teſtimony confirmed the circulation of the blood. Others think

 that

that it is not as yet ſufficiently illuſtrated, and free from objections; and others again cry out, that I have affected a vain commendation of myſelf from diſſecting of living animals, among which they deride my having made mention of frogs, mice, and other ſuch contemptible creatures, and do not refrain from the moſt opprobrious language. It cannot be helped, adds Harvey, but that dogs will bark, and cynics pretend to mix with philoſophers, but I ſhall take ſpecial care, that they do not bite, and deſtroy with their dogs teeth the very marrow of truth. They rail againſt me, becauſe I do not anſwer the ſurfeits they have belched up. Detracters, mimics of men; let them know, that I never intend to read works that can have nothing of ſolid ſenſe in them, much leſs ſhould I eſteem them worthy of an anſwer. It would be unworthy of me to return opprobrious language for theirs. I ſhall do better, for *I will overcome oppoſition by truth*; and if they will conſider with me the anatomy of the vileſt inſect, they will find a GOD equally in the humbler, as in the higher works of creation.

Such, however, was the power of prejudice, that it is obſerved by Harvey that no phyſician paſſed the age of forty believed in his doctrine, and that his practice declined from the moment he publiſhed this ever-memorable diſcovery.

The new doctrine at laſt getting into ſome vogue, the

ſenior

senior physicians, says Malpighi, were inflamed to such a pitch at Bononia, that in order to root out heretical innovations in philosophy and physic, they endeavoured to get an act passed, whereby every graduate should be obliged to take the following *additional clause* to his solemn oath on receiving his degree; "*You shall likewise swear that you will, with all your might (pro toto tui posse) preserve and defend the doctrines of* Hippocrates, Aristotle, *and* Galen, *which are taught in this university, and have been approved of during a long series of ages; and that you will not permit their principles and conclusions to be overturned by any person whatsoever.*"

Here it may be useful, adds the justly celebrated Dr. Hunter, as well as entertaining, to remark, that *improvements* in medicine have always been among men an object of contention. A little reflection on human nature will shew that *vanity* is the principle source of *this absurdity*. All men wish to be respectable; and most of them to pass in the world, *for what they are not*; for being *so very acute, judicious,* and *learned*, as to need *no new instructions*. Hence *professors* assume a decided and dictatorial character, affecting to have gone to the *bottom of every thing*, and to have *overcome every difficulty*, either by the natural powers of their understandings, or by the severity of their studies, and perseverance in the pursuit of knowledge. *Old men*, besides, can seldom bear, what they think an inversion of

 the

the natural order or things, that younger persons should instruct them. Of all men, *teachers* of every kind bear this with most impatience. For that reason we see, in fact, that the *seniors of schools, colleges*, and *public foundations*, have generally been the most obstinate *in shutting out light*, and claiming a *birth-right* for *opinions*, as for *property*. It is easy to see that *such men* will resist *new doctrines* with more obstinacy than the rest of mankind, perhaps with *inveteracy*, in proportion as the doctrines *are well founded* and *readily credited*. They will be sensible that many persons who embrace the *new opinion*, will call to mind *many looks of importance*, and *expressions of vanity*, which must *now* appear truly contemptible. Dr. Harvey, a few years before his death, had the happiness, however, to find the clamours of ignorance, envy, and prejudice, silenced; and *professional men* grew at last ashamed to own, that they had *ever* combated or disbelieved the *circulation of the blood*.

The doctrine taught by Harvey is,

That all the veins of the body falling into *two trunks*, viz. the *ascending* (1), and *descending*, *cavæ* (2), empty themselves into *the right auricle* of the heart (3). *The right auricle* unloads into *the right ventricle of the heart* (4), *which* throws the blood through *the pulmonary artery* (5) into *the lungs*, by its *two branches* (6) (7), which go to the *right* and *left lobes*.

From *the lungs* the blood is brought back by *the four*

four pulmonary veins (8), (9), (10), (11), into *the left auricle* (12), and from thence it paſſes into *the left ventricle* (13), by *which* it is diſtributed through *the body* by means of *the aorta* (14), and its branches. *Theſe* terminate in *the veins* of the body, which collect the blood and bring it back to the heart by the *two cavæ* (1) (2). Or, in other words,

That the *heart* is divided into 2 *parts* by a *longitudinal fleſhy* ſeparation. *Theſe* 2 *parts* are formed into 2 *cavities* by a *lateral membranous valvular* ſeparation.

The *veins* * enter the 2 *upper cavities*, or *auricles*, and the *arteries* † go out from the 2 *lower cavities*, or *ventricles*.

When the *auricles* contract, the blood is driven into the *ventricles*; and when *theſe* contract, it is forced into the *arteries*.

Then *commences*, in fact, *the double circulation of the blood*.—The *arteries* † contract, and the blood flows from the *right diviſion* of *the heart through the lungs*, to enter the *left diviſion* of *the heart*:—and from the *left diviſion* of *the heart*, the blood paſſes *through the various parts of the body* to enter again the *right diviſion* of *the heart*.

Such indeed are the *admirable organs* [illegible] for *the circulation of the blood*. But [illegible] does this imperfect ſketch fall ſhort of [illegible] How incapable are theſe outlines of [illegible] beauties of this noble ſubject!

* Viz. the *two venæ cavæ*, and *the four pulmonary veins*.

† Viz. the *aorta*, and the *pulmonary artery*. Vide Map of

There is in the consideration of *the organs* performing the circulation of the blood, an air of *grandeur* that seizes forcibly on the mind, and penetrates it with the highest admiration *.

Far *less magnificent* their plans, *less skilful* in the execution of them, *hydraulics* offer us but *faint* [illegible] of this miracle, in those machines, by means of which water is distributed into every quarter of a great city.

The works of the CREATOR must be compared to the *emanations* of the same *infinite mind*. Ever like himself, *he* has impressed on all *his* productions a character of noblenesss and excellence, which demonstrate their *divine original*.

* When the coloured plates of the heart of the natural size (these represent the front and back view of the heart with the pulmonary vessels) were shewn to that great architect Sir William Chambers, and the circulation there explained was read by him, he held up his hands with astonishment and admiration. These two superb plates, with explanations, published by Dr. Thornton, form the first Number, and are sold by Symonds at ten shillings and sixpence each Number. Mr. Cruikshank in his public lectures always exhibits them to his pupils, recommending them in the strongest terms. They are the commencement of a series of anatomical plates of the size and colour of life, the parts injected, and, as being more permanent and cleanly than the real subject, will meet, we trust, with the countenance of the public at large.

Numbers III. and IV. exhibiting the interior structure of the heart, [illegible] in the hands of the Engraver, and will be speedily published; also Numbers V. and VI. shewing the nerves of the heart, and Numbers VII. [illegible] the heart and lungs in their natural [illegible] themselves to our view. This work will be completed in [illegible] twenty numbers, exclusive of the muscles and ligaments [illegible] the bones are not com-

SECT. XVII.

ON THE PULSATION OF THE HEART AND ARTERIES AS DEPENDANT UPON VITAL AIR.

Hinc quoque apparet sanguinis prin. *pulsus ex eo ortum ducat.* Nec sanguis solum pars primigenia et principalis dicendus est, quod ab eo motus pulsusque principium orietur; sed etiam quia in eo primum *calor animalis* innascitur, *spiritus vitalis* ingeneratur, et *anima ipsa* consistit. HARV. Exer. 51.

Hence also appears the *pre-eminence* of the blood, that the *pulsation* of the *heart* and *arteries* owes *its origin* to it. Nor is the blood to be called the *first mover* and *pre-eminent* for this alone, but because from it springs the *vital heat*, the *animal spirits*, and life itself. Harvey's 51st chapter.

How infinitely near does the immortal Harvey approach the truth, and yet, I believe, he had not the most *distant conception*, that OXYGEN AIR was the *principle* from whose *benign influence* all *these wonderful phenomena* arise.

It is the study of air, and aerial fluids, that has brought to light all the beautiful discoveries which modern physiology can boast of.

In the last section it was shewn, how the blood was

was a fluid of a rich *vermilion colour* in the *arteries*, and of a ſtrong *purple colour* in the *veins*. When Dr. Goodwin opened the thorax of a living dog, the lungs being collapſed, the heart ſoon ceaſed to play, the animal then languiſhed, and ſeemed expiring, but was revived again when *air* was blown into his lungs: then began again the motion of the heart; the blood receiving the ſtimulating influence of *vital air*, acted on the left ſide of the heart, and the right ſide moved in ſympathy *, and the circulation was excited anew, and life continued. Now, this change in the motion of the heart happening ſo plainly from acceſs of *air*, is a circumſtance of the moſt intereſting nature, and obliges us to look into the doctrines of chemiſtry for the ſolution of a phænomenon to which there is in the whole animal œconomy nothing to be compared.

On this occaſion it is obvious to remark the *importance of the* LUNGS; we perceive that the blood, every time it is *returned* to the *right ventricle* of the

* The right ſide of the heart pulſates, although it receives only *venal blood*. To ſolve this difficulty we are obliged to uſe the word *ſympathy*; thus if the noſtrils be irritated, the muſcles of the diaphragm are thrown into ſpaſmodic action, and an irritation of the ſtomach brings into action all the abdominal muſcles. Thus a diſeaſe of the kidney is marked by a numbneſs along the thigh, a gall ſtone by vomiting, and a diſeaſe of the liver by pain on the ſcapula. Of the cauſe of this connexion we are ignorant, and therefore are reluctantly obliged to have recourſe to the term *ſympathy*.

heart,

heart, is directly diſperſed through *the lungs*, and *immediately reconveyed to the heart, before it is permitted to begin a new circulation*; I may add before it is *capable* of performing a *new circulation:* for had there been no real neceſſity, we may boldly aſſert, this operation of the blood *paſſing from the right ſide of the heart through the lungs to the left* would never have taken place. In the ſtudy of nature, throughout all her works, however *complex* the machine, the *utility* of each part ever claims the admiration of the ſpeculative mind. This obſervation is beautifully illuſtrated on the preſent occaſion; and I believe it will be admitted by every one, that the blood, after having performed *one round* throughout the animal œconomy, undergoes ſome *new* and *important change*, in its *tranſit through the lungs*, eſſentially requiſite to ſupport a *ſecond circulation*. This change is certainly the *oxydation* of the blood, and we ſhould expect, if *oxygen* be the natural ſtimulus * to the heart and arteries, that their pulſation would be in proportion as the blood had acceſs to this principle. That this is really the caſe, appears from the following

* As a negative proof, we have thoſe experiments where perſons have breathed a reduced atmoſphere. One conſumptive patient, contrary to my judgment, ſays Dr. Beddoes, uſed to inhale at times air wholly deprived of *oxygen*. During this proceſs I have felt the pulſe nearly "*obliterated*." He loved to indulge in it, and deſcribes the incipient inſenſibility produced on him as a ſtate highly delightful. Vide Dr. Beddoes's *Obſervations*, p. 30.

experi-

experiment, made before a most respectable society of gentlemen, who met once a week at Dr. Higgins's for the purpose of making philosophical experiments. Although Mr. Taylor was not more than 22 years of age, his natural pulse was only 64 previous to the experiment we are about to relate. During the inhalation of 19 pints of *oxygen air*, his pulse, as Dr. Higgins remarked, was quickened to 90 *beats in a minute*, and was considerably increased in *fulness* and *strength*. The vessel being immediately charged again with 19 pints of pure *oxygen gas*, he respired these also, and consumed them entirely in six minutes. His pulse was in consequence increased to 120 *beats in a minute*, and was *vigorous withal* *.

* See *Minutes of the Society for Philosophical Experiments* p. 146

SECT.

SECT. XVII.

ON THE VITALITY OF THE BLOOD.

THE intimate connexion, which ſubſiſts betwixt the life of man, and the air he breathes, was entertained in the remoteſt ages. Some even ſuppoſe that, ſpeaking of the creation, when Moſes ſays, "GOD breathed into man the breath of life," he alludes to this intimate union, and that "in the image "of GOD created HE man," relates more particularly to the union of ſoul and body. It is thus with the new born infant; the firſt thing we do is to infuſe into his noſtrils "the breath of life." For until the lungs are expanded, and the *venal*, or *purple* blood is changed into *arterial*, or *crimſon*, in that organ, the heart does not contract, nor the arteries vibrate; and like a clock, that is not wound up, though ſound in all its parts, they remain entirely at reſt. In the clock, if we but wind it up, the main ſpring applying its powers, all the wheels are immediately put into motion, and it marks its hours and its minutes; ſo likewiſe in the animal machine, the blood in the lungs having imbibed the *vital principle* of the air, the heart acquires its actions, the brain its energy, the nerves their ſenſibility, and the other ſubordinate ſprings of life preſently reſume their reſpective functions.

The

The lady of Dr. Lind, of Windſor, had a child *ſtill-born* All the common means were tried without effect. Recollecting he had a bladder of *vital air*, with which he was about to make an experiment, he forced this air into the lungs of the infant, when the eddies of its little heart began to play, and the child was reſtored.

Hence the injunction to the Jews in *Leviticus* againſt eating blood, " for the *blood* of the animal " is the *life* thereof." Thus Virgil ſays in the *Æneid*,

Vitam cum ſanguine fudit.

And again,

Unâ eâdemque viâ ſanguiſque animuſque ſequuntur.

And ſpeaking of the death of Rhœtus, the poet again ſays,

Purpuream vomit ille animam.

It would be tedious to quote all the ſuggeſtions of this ſort entertained by the ancient phyſicians *.

The immortal Harvey was chief among the moderns who taught the *vitality* of the blood. He concludes his fifty-ſecond diſſertation with theſe memorable words: " Inde concludimus ſanguinem per " ſe vivere." " Hence we conclude that the " blood lives." This opinion of the *vitality of*

* Have the ancients named the *arteries* from αερ, *the air*, ſuppoſing theſe to carry the air to the living body along with the blood, which modern phyſiology has particularly confirmed?

 the

the blood was however neglected, until it was revived by Hunter *, who taught in his lectures, that the *fluids* as well as the solids were possessed of the *principle of life*. That the blood has *life*, is an opinion, says he, that I have started above thirty years, and have taught it for near twenty years in my lectures; it does not therefore come out at present † as a *new* doctrine, but has had time to meet with considerable opposition, and also to acquire its advocates. To conceive, that the blood is endowed with *life*, while circulating, is perhaps a

* HUNTER, like HARVEY, presents us with many indications of a great and original mind: he had acute discernment, unwearied application, original remark, bold inquiry, and a clear, forcible, and manly reasoning, and his name is deservedly illustrious on account of the many observations and improvements he made in anatomy and physiology; and every one who considers the surprise which his doctrines excited among medical men of his day, and the strong opposition they met with, will allow that the opinions he held were novel, or appeared to him new, which entitles him to the first rank in the class of eminent discoverers, ancient or modern. The doctrines of *Pneumatic Medicine* may be found throughout his works, and, like meteors, they often shine forth amid the thick gloom that then pervaded physiology. Once speaking to the author of this work on the subject, HUNTER said, "Whoever "shall hereafter investigate the operation of the dephlogisti- "cated, and other airs, in the animal œconomy, and will pur- "sue my ideas of the *vitality* of the blood, he will become a "benefactor to mankind, and his name will be immortal."

† Vide his Work on the Blood, from which this section is taken nearly *verbatim*.

stretch

ſtretch of the mind; but the difficulty ariſes merely from its being a *fluid*, the mind not being accuſtomed to the idea of a *living fluid*. Let us however weigh the queſtion well, for it is not leſs difficult for a man born in the Weſt Indies to conceive water as a *ſolid*. I recollect a perſon from Barbadoes, walking out with me early one froſty morning, and I obſerved to him "It was a froſt." He immediately caught up the ſtrange word froſt, and aſked me how I knew it was a froſt. "Becauſe," ſays I, "I ſee ice." He aſked "where." Having ſhewn him an icicle, he could not believe it had been water, and put his finger upon it, and with ſuch caution, as beſpoke a mind ignorant of what he had to meet; and feeling reſiſtance, he drew his hand back; then looking at the ice, he grew more bold, broke it, examined it, ſaw it melt, and believed it to have been water. Thus when all the circumſtances attending the blood are fully conſidered, the idea that it poſſeſſes *life* will be eaſily comprehended.

Firſt, *living matter has the power of reſiſting putrefaction.* Our ideas of life have been too much connected with organic bodies, and principally thoſe endowed with viſible action, hence it requires ſome reflection to be convinced, that theſe circumſtances are not inſeparable. I was led, ſays the illuſtrious Hunter, to this notion in the year 1756, when I was obſerving the proceſs of incubation. I then noticed, that whenever an egg was hatched, the yolk was always perfectly ſweet to the very laſt; and that

part

part of the albumen, which is not expended in the growth of the animal, ſome days before hatching, was alſo ſweet, although both were kept in a heat of 103° in the hen's egg for three weeks, and in the duck's for four. I obſerved, however, that if an egg did not hatch, it became putrid, like other dead animal matter. It is thus with the *blood*: while alive in the body, at the temperature of 97, it reſiſts putrefaction; but when drawn from a vein, it then putrefies like other dead animal matter.

Secondly, *living matter has the power of reſiſting the operation of cold.* Having put a new laid egg into a cold about 0, I imagined that the preſerving power of life was deſtroyed by ſuch a degree of cold. I then put this dead egg, as I ſhall call it, with one newly laid, into a freezing mixture. The former was frozen ſeven minutes before the other.

A new laid egg was put into a cold of 15°, it took half an hour before it was frozen, but when thawed, the ſame being placed under ſimilar circumſtances, took only a quarter of an hour, and the ſame experiment was repeated with nearly the ſame reſult.

Similar experiments were made with the *blood*. After a portion of blood had been frozen, and then thawed, it has again been frozen with a ſimilar quantity of freſh blood drawn from the ſame perſon, and that which had undergone this proceſs, froze again.

I obſerved, in [illegible] the ſap of trees

would freeze at 32° when taken out of the veſſel of the tree, but the ſame was not frozen when the heat of the tree ſtood often ſo low as 27°.

Thirdly, *the blood obeys the ſame laws as the living ſolids*. The following experiments were made on living muſcles, to ſee how far the *contractions* of living muſcles, after having been frozen, correſponded with the *coagulation* of the blood.

From a ſtraight muſcle in a bullock's neck, a portion, three inches in length, was taken out immediately after an animal had been knocked down, and was expoſed to a cold below 0, for fourteen minutes. At the end of this time it was frozen exceeding hard, was become white, and was two inches long. It was now gradually thawed, and in about ſix hours after thawing, it was contracted ſo as to be only one inch in length. Here then were the juices of muſcles frozen, ſo as to prevent all power of contraction in their fibres, without deſtroying their life, but when thawed, they ſhewed the ſame contractile power as before.

This is exactly ſimilar to the freezing of *blood* too faſt for its coagulation, which, when thawed, does afterwards coagulate. To prove this by experiment, I took a thin leaden veſſel, with a flat bottom, of ſome width, and put it into a cold mixture below 0, and to run from a vein into it as covered its The blood froze immediately, and fluid, and coagu-

7 ite

lated, I think, as ſoon as it would have done had it not been frozen.

In the ſpring of 1776, I obſerved, that the cocks at my country houſe had the combs ſmooth with an even edge, and not ſo broad as formerly; appearing as if nearly one half had been cut off. Having inquired into the cauſe of this, my ſervant told me, that it had been common during that winter. He obſerved that the comb of one cock being froſt-bitten had entirely dropt off. I endeavoured to try the ſolidity of his remark by experiment. I attempted to freeze the comb of a very large cock, and ſucceeded in freezing the ſerrated edges, which were fully half an inch in length. The frozen parts became white and hard, and when cut through, neither did it bleed, nor the animal ſhew any ſigns of pain. I next introduced into the frigorific mixture one of the cock's wattles, which was very broad and thin. It froze very readily, and upon thawing both the frozen parts of the comb and wattle, they became warm, but were of a purple colour; the wound in the comb now bled freely; both comb and wattle recovered perfectly in about a month, the natural *florid* colour increaſed gradually, until the whole had acquired an healthy appearance.

Finding that freezing both the *ſolids* and the *blood* in them did not deſtroy the life in either *, nor the

* Leeches may be frozen quite ſtiff in ice, as dually thawed, they become as vivacious as ever.

B b

future actions of the veſſels, and that alſo it did not prevent the blood from recovering its *fluidity*, I conceived that the life of both ſolids and fluids are *ſimilar*, and what will affect the one, will affect the other alſo, though probably not in an equal degree; for in theſe experiments the blood was under the ſame circumſtances as the ſolids, and retained its life; that is to ſay, when the ſolids and blood were frozen, and afterwards thawed, they both afterwards were capable of carrying on their functions, and were not rejected as extraneous bodies.

It is to me ſomewhat aſtoniſhing, that the idea of the *vitality* of the blood did not early ſtrike medical inquirers, conſidering the ſtreſs which they have laid on the appearance of this fluid in diſeaſes; ſince this fluid was expreſſive of diſeaſe more than any other part of the animal œconomy, and yet all theſe changes muſt have ariſen from, what ſhall I term it? a *dead* animal fluid, on which diſeaſe had ſuch an extraordinary power.

While the blood is circulating, we know it has the power of preſerving its *fluidity*. This is not produced by motion alone, for in torpid animals, when almoſt in a ſtate of death during the winter, when the blood is moving with extreme ſlowneſs, and would appear to preſerve ſimply animal life through the whole body, the blood does not *coagulate*.

Now, as the *coagulation* of the blood appears to be that proceſs which may be beſt compared with the *action of life* in the ſolids, we will conſider this

property

property a little further, and fee if this power of coagulation can be deftroyed, if it can, we fhall next inquire, if by the fame means life is deftroyed in the folids, and if the phænomena are nearly the fame in both.

As the heat of 120 degrees excites the blood to *coagulate*, I wifhed to try how far *mufcular contraction* was fimilar in this refpect. I took a piece of a mufcle from a fheep newly killed, and put it into water heated to 120 degrees, when it contracted directly, fo as to become hard and ftiff.

Animals killed by lightning, and alfo by electricity, have not their mufcles contracted, in fuch cafes the blood does not coagulate. I faw two deer, who were hunted until they dropt down and died; in neither did I find the mufcles contracted, nor the blood coagulated. Blows on the ftomach kill immediately; and the mufcles do not contract, nor does the blood coagulate.

In the Weft India iflands they kill their poultry with vegetable poifons, in order to render them tender without keeping, in which cafe the blood does not coagulate. For the fame reafon, the expedient was devifed to fatisfy fhameful gluttony, nar the flogging of animals to death.

The general debility, and laxity of the mufcles, brought on after repeated venefection, and the great proftration of ftrength, and even death, produced by hæmorrhage, when the evacuation of the blood is confiderably and fuddenly made, muft be confi-

dered as a ſtrong proof, added to the thin ſtate of the blood, of the living principle being inherent in the blood, and of its having a ſimilar nature as the muſcular fibres.

On the contrary, in diſeaſes where the action of the heart was going on very ſtrong, the muſcles after death contract ſtrongly, and the blood ſtrongly coagulates. This *coincidence* of *coagulability* in the *fluids*, and *contractility* in the *ſolids*, that is, both *ſhortening their dimenſions, and being obedient to the ſame laws*, clearly proves that they both depend on the *ſame cauſe*.

The living principle, therefore, in the *blood*, which I have endeavoured to ſhew to be ſimilar to the living principle in the *ſolids*, owes its exiſtence to the ſame matter which belongs to the other, which is the *materia vitæ diffuſa*, of which every part of an animal has its proportion: it is as it were diffuſed through the whole *ſolids* and *fluids*, making a neceſſary conſtituent part of them, and forming with them a perfect whole; giving to both the power or ſuſceptibility of impreſſion; and, from their conſtruction, giving them conſequent reciprocal action.

SECT. XVIII

THE VITALITY OF THE BLOOD IS DERIVED FROM THE AIR.

The *life* of the animal then, ſays Hunter, ariſes from the *blood*; but the *blood* itſelf muſt be kept *alive*. Whence then the *life of the blood?*

To accompliſh this it muſt have motion to and from the heart; from the heart it is ſuperſaturated, if I may be allowed the expreſſion, with the *living principle*, with which it parts as it viſits the different portions of the body.

This *living principle* in the *blood*, which, ſays Hunter, I have endeavoured to ſhew was *ſimilar* to the *living principle* of the *ſolids*, owes its exiſtence to the *ſame matter* which belongs to the other, and is *that principle* of which every part of an animal has its portion; it is diffuſed through both ſolids and fluids, making a neceſſary conſtituent part of them, and forming the perfect whole, giving them both the power of preſervation from putrefaction, and from cold, and ſuſceptibility of impreſſion, which keeps up the harmony betwixt the fluids and ſolids, and accounts for that reciprocal influence which each has on the other.

The *materia vitæ diffuſa*, this *univerſal living prin-*

ciple, is not, I conceive, derived from the energy of the *brain*, or from *nerves*, for if nerves, either of themfelves, or from their connexion with the brain, gave *vitality* to our fluids and folids, how fhould the circulation continue; and the folids be alive, after a nerve was deftroyed? or ftill more after paralyfis? for the limbs continue alive, blifters draw, wounds heal, parts are nourifhed, though robbed of voluntary action and feeling; but deprive them of their blood, by tying the arteries, and the parts immediately mortify.

We are come now more particularly to the confideration, *Whence this living principle?*

We are led by daily experience to obferve, that the dark blood taken from a vein becomes red on that furface which is expofed to the *common atmofphere*, and that if fhaken in a phial with air, the whole becomes red, but *in vacuo*, however fhaken, there is no rednefs. Thus if blood be allowed to ftand expofed to the air, and coagulate, its upper furface will become of a fcarlet red, while the bottom remains dark. If the coagulated blood be inverted, and the bottom, which has been turned upwards, be expofed to the air, this part will alfo affume the fcarlet red.

The red will even penetrate fome depth, and even pervade a moiftened bladder; fo that if venal blood be received into one, and it coagulates, the whole globe will be one uniform fcarlet on the outfide,

as may be proved by cutting any part of the bladder.

We find alſo by experiment, the veſſels in the lungs being full of blood, are of a dark colour when the trachea is tied; but upon inflating the lungs, the cells will inſtantly contain florid blood, the ſmall veſſels pervading thoſe cells, whether arteries or veins, having the modena colour of the blood immediately changed by the air paſſing through their coats.

The ſcarlet blood is therefore that blood which has imbibed air in the lungs, and paſſes into the arteries, where it is more commonly ſeen; hence it is called arterial blood, and the modena, or lake, is the venal blood of the body, as alſo of the pulmonary artery of the lungs. This is ſo well known that there need hardly any proof of it. I bled a man, continues Hunter, in the temporal artery, and in a vein of the arm at the ſame time. The blood was received into different cups. The blood of the artery was of a florid red, that from the vein was dark.

To prove that this florid colour ariſes in the living animal from the abſorption of air in *breathing*, I fixed the nozzle of a bellows into the trachea of a dog, and immediately began artificial breathing. I then removed the ſternum and cartilages, and opened the pericardium. While I continued the artificial breathing, I obſerved that the blood in the pulmonary veins and aorta was either crimſon, or modena,

juſt as I threw air into the lungs, or not. I next cut off a piece of the lobe of the lungs, and found that the colour of the blood which came from the bleeding wound correſponded with the experiment above. When I threw air into the lungs, the pulmonary veins and aorta looked red, and ſcarlet blood iſſued from the wound; and when I deſiſted from throwing in air, the blood paſſing from the wound was of a dark colour.

I bled a gentleman in the temporal artery, while in a fit of apoplexy; he breathed at that time ſeemingly with great difficulty, the blood flowed freely, but was of a dark venal character; he ſoon after was relieved, his breathing became free, and the blood from the temporal artery now flowed as crimſon as ever.

Mrs. ——, of Norris-ſtreet, Haymarket, fell into an apoplectic fit, in which ſhe was inſenſible: the breathing was ſhort, attended with a rattling of the throat, and a ſnorting. I judged it right to open the temporal artery, and it bled freely; and I obſerved, that while her breathing was difficult, or when ſhe hardly breathed at all, the blood was modena; and when ſhe breathed eaſier, the blood became immediately ſcarlet, and this alternated ſeveral times in the courſe of the bleeding.

A. B——, when a boy, could never uſe the ſame exerciſe as other boys; he could not run up ſtairs, nor aſcend a hill without being out of breath. Upon the leaſt motion he had palpitation of the heart.

which was ſo ſtrong as to be heard by thoſe near him; but his becoming ſo ſoon fatigued was ſuppoſed by his acquaintance to be owing to a want of ſpirit. While a child, crying would bring on palpitation, and ſuffocation; and as ſuffocation always ariſes from a want of the due influence of pure air on the blood, while the circulation was going on, the whole body muſt change from the ſcarlet tinge to the modena or purple, as was the caſe, and in particular ſhew itſelf in thoſe parts where the blood imparts its colour moſt, as in the face, lips, fingers ends, &c. Neverthelеſs he grew to be a well-formed man, but he ſtill retained thoſe defects, which, indeed, rather increaſed as he enlarged his views, and with them his actions. He conſulted ſeveral phyſicians. The difficulty of breathing, the great oppreſſion, the blackneſs in the face, I ſuppoſe they thought aroſe from ſpaſm, or was nervous, for they ordered cordials, as ſpirit of lavender, &c. I was conſulted next. Upon inveſtigating all the ſymptoms, my opinion was, that there was ſomething wrong about the conſtruction of the heart; that in conſequence the blood not flowing freely could not have the proper influence of the air in the lungs, hence the reaſon of the darkneſs or lividneſs of the complexion when attacked upon uſing more exerciſe than was proper. He was directed, as he could hardly uſe any exerciſe of his own, to have motion given him, ſuch as riding in a carriage, and with great care he was directed to ſuppreſs ſuch actions

as he found from experience brought on these fits of suffocation. He was to lose a little blood at the time of attack; but all these precautions hardly kept him tolerably well. At length other disorders supervening, he died, and I had the satisfaction of opening the body. I found the viscera sound, but upon examining the aorta, as it passes from the left ventricle of the heart, I found the aorta, and its three semilunar valves, ossified. This diseased state of the aorta, and its valves, accounts for every one of his original symptoms, and as such afford very little use to the practitioner in order to accomplish a cure; the blood there, upon any unusual extension, must have fallen back into the ventricle, and have overloaded the heart, impeding the circulation, and consequently the necessary change of blood in the lungs.

The vast number of cells into which the lungs are divided, the whole arterial and venal system ramifying on the surface of those cells, and of course the whole of the blood passing through them in every circulation, together with the loss of life upon missing three or four breathings, shew the power of the *air* upon [illegible] or the purposes of life; and the time we can live without breathing, being shorter than that in which we can die from a defect in any other natural operation, all seem to prove, that the *air* somehow bestows life on the [illegible] and the blood continues it, by [illegible]g this same vital principle to every part of the body. — [illegible] ce it is to the *atmosphere* (or rather to that particular part of

it which goes by the name of *vital*, or *oxygen air*) that we are indebted for *that vitality* which is communicated to the *blood*, and which *animates* our *bodies*, and is the immediate bond of union betwixt our immaterial ſoul and this viſible world.

We may be compared to ſmall pieces of feather placed upon an electrical machine, which while the handle is turned, dances upon the conductor, but the moment of ceſſation, they all drop: ſo we are ſupported upon this ſolid globe, and each plays his part; but were once the air to be removed we ſhould immediately fall down, as thoſe ſtricken in the deſerts of Arabia by the Hattan or ſcorching wind.

Reſpirable air, ſays John Hunter, has the property of heightening the red colour of the blood to a ſcarlet; and *this*, with its conſequent *heat*, is ſuppoſed to be the chief or only uſe of *reſpiration*:—but if we ſuppoſe the change of colour in the red globules to be all that *reſpiration* is to perform, we ſhall make the *red globules* the moſt *eſſential* part of the blood, whereas that may be ſaid to be the leaſt. It is moſt probable, that *the effect* of *air* on *the blood* is greateſt on the *coagulable lymph*; and this conjecture is rendered more likely, when we conſider, that in cold animals, which have no red globules, *reſpiration* is as eſſential to their exiſtence as in any other.

Having at hand ſome water from the hot-well at Briſtol, which I had found to contain *air* in a ſtate of great purity, I completely filled a large phial of

it, and I put into it a few very ſmall fiſh, which I had provided for the purpoſe of theſe experiments. They were minnows, and other ſmall fiſh about two inches in length. In this water they were confined without any acceſs of common air till they died.

After this I took equal quantities of the water in which the fiſh had died, and of that out of which it had been taken, where they were confined in; and I expelled from both all the air which they would yield. That from the water in which no fiſh had been put, exceeded in quantity that from the water in which they had been confined, in the proportion of 3 to 2; and examining the quality of both theſe quantities of air, by the teſt of nitrous air, the former exceeded the latter in a ſtill greater proportion.

The air from the water in which no fiſh had been confined was at the ſtandard of common air, but that which had been contaminated by the reſpiration, as I muſt ſay, of the fiſh, was ſomething *worſe* than air in which a candle juſt goes out.

From this experiment it may be concluded with certainty, that *air* contained in *the interſtices* of water, is as neceſſary to the life of *fiſh*, juſt as *air* in its *aeriform ſtate* is to that of all *land animals*.

The blood, therefore, poſſeſſes vitality in all its parts, and this vitality, which it communicates to the ſolids, is derived from the oxygen of the [illegible]

SECT.

SECT. XIX.

LIFE OF JOHN HUNTER.

JOHN HUNTER was the ſon of John and Agnes Hunter, of Kilbride, in the county of Lanerk; he was the youngeſt of ten children, and was born on the fourteenth of July, 1728, at Long Calderwood, a ſmall eſtate belonging to the family. His father was deſcended from Hunter of Hunterſton, an old family in Ayrſhire, and his mother was the daughter of Mr. Paul, a very reſpectable man, and treaſurer of the city of Glaſgow.

John Hunter was about ten years old at his father's death, and was left under the direction of his mother, who was particularly indulgent to this her youngeſt ſon. He was ſent to the grammar-ſchool, but not having a turn for languages, nor being ſufficiently under controul, he neglected his ſtudies, and ſpent the greateſt part of his time in country amuſements.

About this time Mr. Buchanan, who had lately come from London to ſettle at Glaſgow as a cabinet-maker, paid his addreſſes to Mr. Hunter's ſiſter Janet, and having many agreeable qualities, ſhe was induced to marry him.

Mr. John Hunter, when at the age of ſeventeen,

went

went to Glafgow upon a vifit to his fifter, for whom he had the greateft affection, and followed this bufinefs; but difgufted, probably, by fo fervile and mechanical an occupation, he fhortly after returned to his mother.

Tired, however, of living idle in the country, he began to turn his mind to fome active employment; and hearing much of the reputation which his brother Dr. William Hunter had acquired as a teacher of anatomy, he wrote up to requeft that he would allow him to come to London upon a vifit, making at the fame time an offer to be his affiftant in his anatomical refearches; or, if that propofal fhould not be accepted, expreffing a wifh to go into the army.

In anfwer to this letter, he received a very kind invitation from his brother, and immediately fet off for London, accompanied by Mr. Hamilton, a friend of the family who was going upon bufinefs; they rode up together on horfeback.

Mr. Hunter arrived in London in September, 1748, about a fortnight before his brother began his courfe of lectures; and from this period we may confider Mr. Hunter as being ferioufly engaged in anatomy, and, under the inftructions of his brother and his affiftant Mr. Symonds, he had every opportunity of improvement, as the chief diffections at this time carried on in London were confined to that fchool.

In the fummer 1749, Mr. Cheffelden, at the re-

queſt of Dr. Hunter, permitted him to attend at Chelſea Hoſpital, and he there learnt the firſt rudiments of ſurgery.

The following winter he was ſo far advanced in the knowledge of human anatomy, as to inſtruct the pupils in diſſection, to whom Dr. Hunter had very little time to pay attention. This office, therefore, fell almoſt entirely upon him, and was his conſtant employment during the winter ſeaſon.

In the ſummer months of 1750, Mr. Hunter attended the hoſpital at Chelſea; in 1751, he became a pupil at St. Bartholomew's, and in the winter was preſent at operations occaſionally, whenever any thing extraordinary occurred.

The following ſummer he went to Scotland, and brought up his ſiſter Dorothea, and in 1753 entered as a gentleman commoner at St. Mary Hall, xford.

In 1754, he became a ſurgeon's pupil at St. George's Hoſpital, where he continued during the ſummer months, and in 1756 was appointed houſe-ſurgeon.

In the winter 1755, Dr. Hunter admitted him to a partnerſhip in his lectures, and a certain portion of the courſe was allotted to him, beſides which, he gave lectures when the doctor was called away to attend his patients.

Making anatomical preparations was at this time a new art, and very little known; every preparation, therefore, that was ſkilfully made, became an

object of admiration; many were wanting for the ufe of the lectures, and the doctor having himfelf an enthufiafm for the art, left no means untried to infufe into his brother a love for his favourite purfuits. How well he fucceeded, the collection afterwards made by Mr. Hunter will fufficiently evince.

Many parts of the human body being fo complex, that their ftructure could not be underftood, nor their ufes afcertained, Mr. Hunter was led firft to examine fimilar parts in other animals, in which the ftructure was more fimple, and more within the reach of inveftigation; this carried him into a wide field, and laid the foundation of his vaft collection in comparative anatomy.

The collection of comparative anatomy which Mr. Hunter has left, and which may be confidered as the great object of his life, muft be allowed to be a proof of talents, affiduity, labour, and original genius. The idea appeared too vaft for man. Of him it may with jufter propriety be faid than of any other man, "Deus creavit, Hunterus difpofuit;" whofe genius cannot be contemplated without furprife and admiration.

In this collection we find an attempt to expofe to view the gradations of nature, from the moft fimple ftate in which life is found to exift, up to the moft perfect and moft complex of the animal creation—man himfelf.

By the powers of his art, this collector has been enabled fo to expofe, and preferve in fpirits or in a dried ftate, the different parts of animal bodies

dies intended for ſimilar uſes, that the various links of the chain of perfection are readily followed and may be clearly underſtood.

This collection of anatomical facts is arranged according to the ſubjects they are intended to illuſtrate, which are placed in the following order:

Firſt, parts conſtructed for motion.

Secondly, parts eſſential to animals reſpecting their own internal œconomy.

Thirdly, parts ſuperadded to purpoſes connected with external objects.

Fourthly, parts relative to the propagation of the ſpecies and maintenance or ſupport of the young.

The FIRST CLASS exhibits the ſap of vegetables and blood of animals, from which fluids all the different parts of the vegetable and animal creation are formed, ſupported, and increaſed. Theſe fluids being more and more compounded, as the vegetables and animals become more perfect, are coagulated and form a regular ſeries. The ſap of many plants does not coagulate ſpontaneouſly, but is made to undergo this change by adding the extract of Gowlard, in this reſpect differing from water: the ſap of ſuch plants is conſidered as the moſt ſimple: in the onion there is a ſpontaneous coagulation: in inſects the blood coagulates, but is without colour: in the amphibia, colour is ſuperadded.

The moving powers of animals, from the ſimple ſtraight muſcle to the moſt complicated ſtructure

of that organ, with the different applications of elaſtic ligaments, form a *ſecond ſeries*.

The growth of bone, horn, and ſhell, come *next in order*; and the joints which admit of their moving readily on one another, *finiſh* this ſubject.

The SECOND CLASS begins with thoſe animals of the hydatid kind, which receive nouriſhment, like vegetables, from their external ſurface, having no mouth.

Then follow thoſe which are ſimply a bag or ſtomach, with one opening, as the polypus, having no organs of generation, as every part of the bag is endowed with that power; but in the leech the ſtructure becomes more complex, for although the animal is compoſed of a bag with only one opening, the organs of generation, brain, and nerves, are ſuperadded, and thence a gradual ſeries is continued to thoſe animals in which the ſtomach forms only a diſtinct part of the animal, for the purpoſe of digeſtion.

The ſtomachs themſelves are alſo arranged in the order of their ſimplicity.

Firſt, the true membranous digeſting ſtomach, then thoſe with the addition of crops, and other bags, to prepare the food for digeſtion, as in the ruminating tribe, and, laſtly, thoſe with gizzards.

Annexed to the ſtomachs, is a very complete and extenſive ſeries of teeth, which are varied according to the kind of food and ſtomach.

After the ſtomachs are the different appearances of the inteſtinal canal, which exhibit almoſt an infinite variety in the ſtructure of their internal ſurface from which the aliment is abſorbed.

The quantity of ſurface is increaſed in ſome by tranſverſe folds, in ſome by ſpiral or longitudinal ones, and in others puts on a loculated appearance, as in the whale.

To theſe are added the glands, connected with the inteſtines, as the liver, pancreas, and ſpleen, which may properly be conſidered as appendages.

After digeſtion, follows the ſyſtem of abſorbing veſſels, the ſimpleſt being the roots of plants, after which are the lymphatic and lacteal veſſels of different animals.

Theſe in the human ſubject and the elephant are ſmall, and in the turtle large and more numerous; but in the ſpermaceti whale, where they are employed for conveying the ſpermaceti, of a ſize infinitely beyond what is met with in any other animal. To theſe are annexed the thoracic ducts in different animals.

The natural order, in following the courſe of the aliment from the ſtomach as a guide, leads from the abſorbents to the heart, which in the caterpillar is a ſimple canal or artery running along the middle of the back of the animal, admitting of undulation of the blood; from this ſimple ſtructure it becomes, in different animals, by ſmall additions, more and more complex, till it arrives at the degree of per-

 fection

fection which is difplayed in the organization of the human heart.

Thefe are followed by the different ftructures of valves in the arteries and veins, and the coats of thefe veffels.

Then the lungs are fhown in all their gradations from the fimple vafcular lining of the eggfhell, which ferves as lungs for the chicken, to thofe of the more perfect animals.

In one inftance, viz. that of the fyren, both gills and lungs are feen in the fame animal.

The windpipe and larynx are then fhown, under all their different forms.

The kidnies, which feparate the fuperfluous fluids from the circulation, make the laft part of this fubject.

The THIRD CLASS takes up the moft fimple ftate of the brain, which is in the leech a fingle nerve with ramifications.

In the fnail, the brain forms a circular nerve, through the middle of which paffes the œfophagus, from which circle there are branches going to every part of the fkin of the animal.

In the infect, the brain has a more compact form, is larger in fifh, but ftill more fo in birds, gradually increafing in fize as the animal is endowed with a greater degree of fagacity, till at laft it becomes the large complex organ found in the elephant and in the human fubject.

The

The coverings of the brain, and the ganglions and peculiarities of the nerves, are annexed.

The organs of ſenſe are arranged in the order of their ſimplicity, beginning with that of touch, which is only a villous vaſcular ſurface, the villi very ſhort where the impreſſion is to be made through a thin cuticle, as in the human finger; very long where the covering is thick, as the hoof of the horſe.

The organ of taſte is only a modification of touch, and therefore nothing in the organization is different, but the varieties in ſtructure adapting the tongue for different purpoſes are numerous; in many animals it anſwers the purpoſe of a hand, to bring the food to the mouth, as in many ſhell-fiſh, the ant-bear, woodpecker, and camelion. Connected with the tongue are the fauces, which in many animals have peculiarities; in the electric eel, they have a very curious carrunculated irregular appearance; but they are yet more extraordinary in the camel, which has an apparatus to moiſten the parts, ſo as to prevent the painful ſenſation of thirſt, thus adapting the animal to the ſandy deſerts which it is deſtined to inhabit; this apparatus conſiſts of a large bag hanging down ſeveral inches in the fauces, and attached to the palate, which the animals can at pleaſure move up and down, and lubricate the fauces.

The organ of ſmell is variouſly conſtructed, and is more complicated in many animals than in man, as in the lion, and ſea-cow. The organ of hearing

in fiſh conſiſts of three ſemicircular canals; but is much more complex in land animals.

The organ of ſeeing is different in thoſe animals which are formed to ſee in water, and in thoſe which ſee in air; it differs again in thoſe which are to ſee with little or with much light; all thoſe peculiarities are illuſtrated by preparations. The pigmentum of the eye in ſome fiſh reſembles poliſhed ſilver; in ruminating animals at the bottom of the eye it has a greeniſh hue, in the lion and cat kind, a portion of the bottom is white; but, as a general principle, the colour of the pigmentum is the ſame as the rete mucoſum of the ſkin of the animal, being white in white animals, and black in very dark ones.

After the brain and ſenſes are arranged the cellular membrane and animal oils, which are followed by the external coverings. Theſe are divided into the different kinds, as hair, feathers, ſcales, &c. with the rete mucoſum, or that membrane which is interpoſed between the true ſkin and the ſcarf-ſkin, for the purpoſe of giving the peculiar colour. Added to theſe are the parts peculiar to different animals, for offence and defence, as ſpurs, hoofs, horns, ſtings, and alſo electric organs. There follow next ſuch peculiar ſtructures as occur in certain tribes of animals, as the air-bladders in fiſh, &c.

Beſides the preparations of themſelves in ſpirits, in a dried ſtate or corroded, ſo as to give the moſt

accurate

accurate ideas of their ſtructure of parts, there is a conſiderable number of very valuable drawings in this collection to ſhow the progreſs of different proceſſes in the animal œconomy, together with ſuch appearances as were not capable of being preſerved.

This ſketch will give an idea, but a very inadequate one, of the ſyſtem which is comprehended in Mr. Hunter's collection.

It alſo includes a very large ſeries of whole animals in ſpirits, arranged according to their internal ſtructure, and many of the moſt rare ſpecimens of preſerved animals in this country, as the camelopardos, guanica, hippopotamus, tapir, argus-pheaſant, &c.

There is alſo a ſeries of ſculls of different animals, to ſhow their peculiarities, and ſkeletons of almoſt every known genus of animals.

There is a large collection of ſhells and inſects; a prodigious number of calculi of different ſorts from the urinary and gall-bladders, the ſtomach, and inteſtinal canal; there are likewiſe the moſt uncommon deviations from the natural ſtructure, both in man and in other animals, preſerved in ſpirits or in a dried ſtate; the moſt extraordinary ſpecimens of this kind are, a double human ſcull perfectly formed, the one upon the top of the other.

To make this collection more complete in every ſubject connected with comparative anatomy, is added one of the largeſt and moſt ſelect collec-

tions

tions of extraneous foffils that can be feen in this country *.

His health was fo much impaired by exceffive attention to his purfuits, that in the year 1760 he was advifed to go abroad, having complaints in his breaft, which threatened to be confumptive. Therefore in October of that year, Mr. Adair, infpector-general of hofpitals, appointed him a furgeon on the ftaff; and in the following fpring he went with the army to Bellifle, leaving Mr. Hewfon to affift his brother during his abfence.

Mr. Hunter ferved, while the war continued, as fenior furgeon on the ftaff, both in Bellifle and Portugal, till the year 1763; and in that period acquired his knowledge of gun-fhot wounds; a fubject which makes no inconfiderable part of his invaluable performances.

On his return to England he fettled in London;

* This mufeum, the grandeft in the world, raifed by the induftry of an individual in a fhort life, which would have conferred even an honour on an age, and that uncommonly induftrious, was at the death of its owner eagerly fought after by foreign courts. The king of Spain made an unlimited offer to the family of John Hunter: but the Britifh Parliament wifhed to fecure to this country fo invaluable a poffeffion, and twenty thoufand pounds is the fum allotted for the purchafe of this mufeum, fo honourable to the founder and the nation. This fum has not, however, been as yet advanced, and the widow and two fons of Hunter have experienced, it is hoped, only a temporary inconvenience.

where

where not finding the emoluments from his half-pay and private practice sufficient to support him, he taught practical anatomy and operative surgery for several winters.

He pursued, with unabated ardour, comparative anatomy, and as his experiments could not be carried on in a large town, he purchased, for that purpose, about two miles from London, a piece of ground near Brompton, at a place called Earl's Court, on which he built a house.

One day two leopards, which were kept chained in an out-house, had broken from their confinement, and got into the yard among some dogs, which they immediately attacked; the howling this produced, alarmed the whole neighbourhood; Mr. Hunter ran into the yard to see what was the matter, and found one of them getting up the wall to make his escape, the other surrounded by the dogs; he immediately laid hold of them both, and carried them back to their den; but as soon as they were secured, and he had time to reflect on the risk of his own situation, *he was so much agitated that he was in danger of fainting* *.

On the fifth of February, 1767, he was chosen a Fellow of the Royal Society. His desire for improvement in those branches of knowledge which might assist in his researches led him at this time to propose to Dr. George Fordyce, that they should

* This is supposed to have laid the foundation of the complaint of which he died.

adjourn

adjourn from the meetings of the Royal Society to ſome coffee-houſe, and diſcuſs ſuch ſubjects as were connected with ſcience. This plan was no ſooner eſtabliſhed, than they found their numbers increaſed; they were joined by Sir Joſeph Banks, Dr. Solander, Dr. Maſkelyne, Sir George Shuckburgh, Sir Harry Englefield, Sir Charles Blagden, Dr. Noothe, Mr. Ramſden, Mr. Watt of Birmingham, and many others. At theſe meetings diſcoveries and improvements in different branches of philoſophy were the objects of their conſideration; and the works of the members were read over and criticiſed, before they were given to the public.

In January 1776 Mr. Hunter was appointed ſurgeon-extraordinary to his Majeſty, and in the ſpring he gave to the Royal Society a paper on the beſt mode of recovering drowned perſons.

In 1781, he was elected a Fellow of the Royal Society of Sciences and Belles Lettres at Gottenburgh.

In 1783, he was choſen into the Royal Society of Medicine, and Royal Academy of Surgery, in Paris.

In this year the leaſe of his houſe in Jermyn-ſtreet having expired, and his collection being now too large to be contained in his dwelling-houſe, he purchaſed the leaſe of a large houſe on the eaſt ſide of Leiceſter-ſquare, and the whole lot of ground extending to Caſtle-ſtreet, on which there was another houſe. In the middle ſpace between the two houſes

he erected a building for his collection. Upon this building he expended above three thousand pounds. In excuse for so inconsiderate a transaction, it can only be said, that the difficulties he had met with in finding ground in an eligible situation, had harassed his mind, already too much occupied, to such a degree, that he was glad to be relieved from that embarrassment, and sacrificed the interest of his family, for the lease did not extend above twenty years.

In the building formed for the collection there was a room fifty-two feet long, by twenty-eight feet wide, lighted from the top, and having a gallery all round, for containing his preparations. Under this were two apartments; one for his lectures, and the other, with no particular destination at first, but afterwards made use of for weekly meetings of medical friends during the winter.

During the execution of this extensive plan I returned, says Mr. Home, his brother in law, to England from Jamaica, where at the close of the war I had been appointed staff surgeon. Sir Archibald Campbell, the governor, coming home, gave me leave of absence on account of my health, and allowed me to attend him.

I found Mr. Hunter, says he, now advanced to a very considerable share of private practice, and a still greater share of the public confidence. His collection kept increasing with his income. In this he was materially assisted by the friendship of Sir Joseph Banks; who not only allowed him to take any

of

of his own ſpecimens, but procured him every curious animal production in his power, and afterwards divided between him and the Britiſh Muſeum all the ſpecimens of animals he had collected in his voyage round the world. To his friends, the honourable Mr. Charles Greville and Mr. Walſh, he was alſo under particular obligations.

Drawing materials from ſuch ample ſources, ſtanding alone in this branch of ſcience, and high in the public eſtimation, he had ſo much attention paid to him, that no new animal was brought to this country which was not ſhewn to him; many were given to him; and of thoſe that were for ſale he commonly had the refuſal: under theſe circumſtances, his collection made a progreſs, which would otherwiſe have been impoſſible.

At this period Mr. Hunter may be conſidered as at the height of his chirurgical career; his mind and body were both in their full vigour. His hands were capable of performing whatever was ſuggeſted by his mind; and his judgment was matured by former experience. He was, at this time, engaged in a very extenſive private practice; he was ſurgeon to St. George's Hoſpital; he was giving a very long courſe of lectures in the winter; he was carrying on his inquiries in comparative anatomy; had a ſchool of practical human anatomy in his houſe; and was always employed in ſome experiments reſpecting the animal œconomy.

Being always ſolicitous for ſome improvement

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in medical education, he, with the affiftance of Dr. Fordyce, inftituted a medical fociety, which he allowed to meet in his lecture-rooms, and of which he was chofen one of the patrons. This fociety, called the Lyceum Medicum Londinenfe, under his aufpices, and thofe of Dr. Fordyce, has acquired confiderable reputation, both from the numbers and merits of its members.

In the fpring of this year he had a very fevere illnefs, which confined him to his bed, and rendered him incapable of attending to any kind of bufinefs.

After his recovery from this illnefs, he was fubject to affections of the heart, upon every occafion which agitated his mind, or required any fudden exertion of the body.

In July 1787, he was chofen a member of the American Philofophical Society.

His collection, which had been the great object of his life, both as a purfuit and an amufement, was now brought into a ftate of perfect arrangement; and he had at length the fatisfaction of giving to the public a feries of anatomical facts formed into a fyftem, by which the œconomy of animal life was illuftrated. He fhewed it to his friends and acquaintances twice a year, in October to medical gentlemen, and in May to noblemen and gentlemen, who were only in town during the fpring. This cuftom he continued to his death.

Upon the death of Mr. Adair, which happened in 1792, Mr. Hunter was appointed infpector-

general

general of hoſpitals, and ſurgeon-general of the army. He was alſo elected a member of the Royal College of Surgeons in Ireland.

In the year 1791, he was ſo much engaged in the duties of his office, as ſurgeon-general to the army, and his private practice, that he had little time to beſtow upon his ſcientifical objects; but his leiſure time, ſmall as it was, he wholly devoted to them.

In 1792, he was elected an honorary member of the Chirurgo Phyſical Society of Edinburgh, and was choſen one of the vice-preſidents of the Veterinary College, then firſt eſtabliſhed in London.

Earl's Court to Mr. Hunter was a retirement from the fatigues of his profeſſion; but in no reſpect a retreat from his labours; there, on the contrary, they were carried on with leſs interruption, and with an unwearied perſeverance. From the year 1 till his death, he made it his cuſtom to ſleep there during the autumn months, coming to town only during the hours of buſineſs in the forenoon, and returning to dinner. It was there he carried on his experiments on digeſtion, on exfoliation, on the tranſplanting of teeth into the combs of cocks, and all his other inveſtigations on the animal œconomy, as well in health as in diſeaſe. The common bee was not alone the ſubject of his obſervation, but the waſp, hornet, and the leſs known kinds of bees, were alſo objects of his attention. It was there he made the ſeries of preparations of the external and inter-

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nal changes of the ſilk-worm; alſo a ſeries of the incubation of the egg, with a very valuable ſet of drawings of the whole ſeries. The growth of vegetables was alſo a favourite ſubject of inquiry, and one on which he was always engaged in making experiments.

In this retreat he had collected many kinds of animals and birds, and it was to him a favourite amuſement in his walks to attend to their actions and their habits, and to make them familiar with him. The fiercer animals were thoſe to which he was moſt partial, and he had ſeveral of the bull kind from different parts of the world. Among theſe was a beautiful ſmall bull he had received from the Queen, with which he uſed to wreſtle in play, and entertain himſelf with its exertions in its own defence. In one of theſe conteſts the bull overpowered him, and got him down, and had not one of the ſervants accidentally come by and frightened the animal away, this frolic would probably have coſt him his life. It produced ſpaſms about the heart.

John Hunter, in the latter period of life, had a diſeaſe of the heart, connected with gout, an account of which he gave in his book on the Blood during his life-time. To prevent the hurry of the circulation he drank water, which did not ſuit his gout; and when treated for the gout, he always found himſelf much diſtreſſed by ſtimulant medicines: which circumſtances may have led him to think leſs highly of phyſic than the art deſerves.

His temper was naturally warm, and he conſtantly dreaded the effects of paſſion, which increaſed both diſeaſes.

An inſtance of the effects of paſſion over him:—One day he was going to Weſtminſter-hall with Mr. Heaviſide, ſurgeon to the king, to hear a trial; the ſtand of coaches in Palace-yard intercepted his paſſage, and he bid one of the coachmen to make way for him. The fellow refuſed, and became inſolent, and John Hunter loſing all temper, gave vent to the moſt terrible execrations, which only produced laughter in the other; and poor Hunter was obliged to go the whole length of the ſtand, all cloſing the tighter their ranks. When he arrived in the Hall, he ſat himſelf down, ſaying, The raſcals have killed me; and Mr. Heaviſide ſupported him in his arms, expecting every moment to ſee the firſt anatomiſt in the world expire in this untoward ſituation.

On October 16, 1793, ſays his biographer *, when in his uſual ſtate of health, he went to St. George's Hoſpital, and unexpectedly meeting with ſome things that ruffled his temper, he allowed himſelf to give way to paſſion; the heart became overloaded with blood, the oſſified aorta † not yielding to the effort of the heart, the countenance became dark, angina pec-

* Mr. Home, his brother-in-law, a ſurgeon of conſiderable eminence.

† This was found to be the caſe upon diſſection after his death.

toris

toris immediately enſued, and turning round to Dr. Robertſon, one of the phyſicians of the hoſpital, he was incapable of utterance, and died. Thus periſhed the greateſt anatomiſt and phyſiologiſt of this age, whoſe premature death muſt be ever lamented by all thoſe who know of how great value, and how ſcarce, ſuch a genius as his was: for when ſhall we ſee his like again!

Mr. Hunter was of ſhort ſtature, uncommonly ſtrong and active, very compactly made, and capable of great bodily exertion. His countenance was animated, open, and in the latter part of his life deeply impreſſed with thoughtfulneſs. When his print was ſhewn to Lavater, he ſaid, "That man thinks for himſelf."

His temper was very warm and impatient, readily provoked, and when irritated, not eaſily ſoothed. His diſpoſition was candid, and free from reſerve, even to a fault. He hated deceit; and, as he was above every kind of artifice, he deteſted it in others, and too openly for his own advantage avowed his ſentiments. His mind was uncommonly active; it was naturally formed for inveſtigation. He required leſs relaxation than moſt men; ſeldom ſleeping more than four hours in the night.

To his own abilities alone he was indebted for the eminence which he acquired in his profeſſion; for although his medical education, his ſituation as ſurgeon at St. George's Hoſpital, and, above all, his brother's recommendation, entitled him to notice, yet

the increafe of his private practice was at firft but flow. The natural independence of his mind led him rather to indulge in his own purfuits, than to cultivate the means of enlarging the fphere of his bufinefs; but the proofs which he afterwards gave of his talents commanded the attention of the public, and procured him a very liberal income.

In private practice he was liberal, fcrupuloufly honeft in faying what was really his opinion of the cafe, and ready upon all occafions to acknowledge his ignorance whenever there was any thing which he did not underftand.

In converfation he fpoke too freely, and fometimes harfhly of his contemporaries; but if he did not do juftice to their merits, it arofe not from envy, but from his thorough conviction that furgery was as yet in its infancy, and he himfelf a novice in his own art; and his anxiety to have it carried to perfection, made him think meanly and ill of every one whofe exertions in that refpect were not fully exerted like his own.

SECT. XX.

LIFE OF LAVOISIER.

Lavoisier was born at Paris, Auguſt 26, 1743. His father, who was very opulent, paid an extraordinary degree of attention to his education, and the young man profited greatly by the inſtructions beſtowed upon him. After having ſtudied the claſſics, and entered on juriſprudence, he afterwards cultivated the ſciences merely from his love of them, and without any fixed object.

In 1764 the government propoſed, as the ſubject of an extraordinary prize, the ſolution of the queſtion relative to the beſt mode of lighting the ſtreets of a great city during the night, and combining together the ſeveral properties of economy, diſtinctneſs of viſion, and facility of operation. The ſum of 2000 livres (about 83l. ſterling), proffered as a reward upon this occaſion, was diſtributed among three artiſts, who had expended ſome money in experiments: the perſon who had treated this ſubject ſcientifically was diſtinguiſhed in a different manner; for the academy ordered the memoir of Lavoiſier to be printed, and he received a gold medal from the king, which was preſented to him by the preſident, in a public aſſembly, on the 9th of April

 1766.

1766. The dissertation in question, which is replete with mathematical and philosophical researches, already announced that the author had commenced the career of the sciences; and, indeed, he never ceased to distinguish himself from that epoch.

On the 10th of May, 1768, he was elected by the academy to supply the place of Baron; he happened to be a candidate at the same time with Jars, an able mineralogist, enjoying the protection of the great, and in whose behalf both Buffon and Trudaine interested themselves; the minister also declared in his favour, for he placed Jars first on the list, although he was only second in respect to votes. The majority contributed to the election of Lavoisier, although younger and less celebrated than his rival, from the consideration that one at his time of life, who possessed such knowledge, talents, and activity, and whose fortune rendered it unnecessary for him to exercise any profession, would become exceedingly useful to the sciences: it accordingly happened that his wealth was always devoted to the advancement of knowledge.

About the same time he published various dissertations in the journals, relative to the project Yvette *, thunder, the aurora borealis, and the

* Le Projet de l'Yvette. Orig. This was a scl
supplying Paris with water, from the neighbourho
village of Yvette, a few miles distant from the capi
same manner as London is supplied by means
River.

cess

ceſs of congelation in the paſſage from water to ice.

He alſo travelled along with Guetard, who devoted his time to the ſtudy of the natural hiſtory of his native country; whence reſulted a manuſcript mineralogical chart of France, which is nearly completed; and alſo a diſſertation on the revolutions that have taken place in the terreſtrial globe, and the ſtrata which compoſe it. Part of this appeared in the memoirs of the academy, and the Journal de Phyſique of 1772.

The memoirs of the year 1778 contain many inquiries relative to the nature of water, and the experiments in conſequence of which the poſſibility of converting it into earth had been inferred. Lavoiſier demonſtrated that the earth found, while diſtilling water, was nothing more than a part of the veſſel decompoſed during the proceſs; on this occaſion he continued the experiment for 101 days. At the end of that period the reſult was, that the total weight of the vaſe and the water remained the ſame, but on examining the particulars, it was diſcovered that the alembic had diminiſhed, and the [illegible] augmented in exactly the ſame proportion. [illegible] demonſtrated, in 1774, that the augmenta[illegible] e metallic calces (chaux metalliques) aroſe [illegible] air confined in the veſſels, and this queſ[illegible] long agitated [illegible] naturali[illegible] was at length [illegible] means of experiments, which were at [illegible] expenſive, and replete with ſagacity: this

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ferved as the foundation of the new chemical theory, and it was by thefe means that he began to attack the doctrine of phlogifton, to which, until then, every thing had been referred.

In 1788 he was enabled to prove that the pureft air, the air eminently calculated for refpiration, the dephlogifticated air of Prieftley, was the conftituting principle of acidity, and that it is common to all acids. He gave the appellation of oxygen to that portion of vital air, which enters into the compofition of all acids that unite with metals, reduces them to the ftate of a calx, and produces vital air when it combines with the principle of heat. This was the fecond marked and decifive ftep taken by him in the chemical theory of which he is undoubtedly the author.

In the month of June, 1783, Lavoifier, who, in purfuance of the principles founded on a theory already confirmed by fo many experiments, had prepared an apparatus on purpofe to communicate a high degree of ignition in clofe veffels to inflammable and vital air, difcovered that there refulted from this combuftion a liquid, which proved to be water in an extremely pure ftate, the weight of which was exactly equal to that of the two airs employed. Having learned that Cavendifh and Monge had already effected the fame refult, he formed another apparatus for the decompofition of water, feparating the inflammable from the vital air, by means of pipes compofed of *iron made red hot*; and it is this

mode which has been a   ted, during the preſent war, to fill the balloons, globes, or montgolfiers, in order to obſerve the motions of the enemy's armies.

Turgot, in 1776, was deſirous of employing him to ſuperintend the manufacture of gunpowder, that he might be thus enabled to contribute to its perfection; and it ſoon attained ſuch a degree of ſuperiority, that the ſame charge was enabled to reach a diſtance of 120 toiſes, which, before his time, only carried 90. The conſequence was, that whereas the Engliſh ſhot, during the war of 1756, reached us (ſays Leland) before we could touch them, and in that of 1778, they complained that they were aſſailed by our balls before theirs could do us any damage.

Some new experiments had nearly coſt him his life, in conſequence of a terrible exploſion that took place at Eſſone, by which many perſons loſt their lives. Theſe enabled him to make a complete analyſis of the nitrous acid; an acid ſo eaſily deſtroyed, ſo difficult in its formation, but which, however, is of the utmoſt importance, ſince it conſtitutes one of the elements of ſaltpetre and gunpowder.

I ſhall not undertake to follow Lavoiſier in the detail of the reſearches made by him relative to the different metallic oxydes, and the quantity of oxygen contained in them; the formation of acids by the humid mode; the affinities of oxygen; the paſſage of this principle from one ſubſtance to another; the cold combuſtions, and the inverſe operations of

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the combuſtion; the ſalubrity of the air, and the circumſtances that alter its reſpirability; the means of correcting, re-eſtabliſhing, ameliorating it, &c. these having been given in a former part of this volume. Such were the immenſe objects of his inquiries relative to the moſt important branches of the new chemiſtry.

In 1789 Lavoiſier attempted to arrange the reſults of his experiments in a methodical order, and thence to form his work, entitled, "Des Elémens de Chemie," (Elements of Chemiſtry). Two editions of this publication were already ſold, and he was preparing a third, much more extenſive than the former, which gives an entire new form to the ſcience.

It is impoſſible to determine what has, or what might have been the influence of the labours of Lavoiſier in manufactures, &c. But one may judge from this circumſtance, that chemiſtry has entirely changed the proceſs of dying; nearly all the phenomena, at preſent preſented by this art, are now reduced to the principles of combuſtion and decombuſtion; more eſpecially ſince the important work of citizen Bertholet, "Sur la Teinture," (On Dying). This, which was formerly, in a great meaſure, empirical, is now conducted by means of a theory equally ſimple and luminous.

The proceſs of extracting metals from their mines, of melting and manufacturing them, of converting iron into ſteel, of bleaching linen, wax, &c. in ſhort, nearly

nearly all the chemical arts, have approached rapidly towards perfection under the guidance of the new chemiſtry.

By applying theſe diſcoveries to the phenomena of reſpiration, Lavoiſier has ſhewn that this vital function is a real combuſtion of *carbon* and *hydrogen*, and that it proceeds from the formation of carbonic acid and water. *Animal heat* is the reſult of this combuſtion, and he was, at length, enabled to determine the quantity of it. In ſhort, the experiments before alluded to conducted him to the intimate connexion ſubſiſting between the acceleration of reſpiration, and that of circulation and tranſpiration, and alſo between their different forces, and the employment of theſe forces by the animal; we alſo know, that he had long meditated an extenſive work on digeſtion.

The laſt, and perhaps the moſt important labours of Lavoiſier, were directed to the tranſpiration of animals; the papers on this ſubject were read by him, before the academy, on the 4th of May 1791. Lavoiſier begins by obſerving, that the animal machine is kept together by reſpiration, tranſpiration, and digeſtion. He enters into a chemical analyſis of the effect of each, and the nature of cutaneous and pulmonary tranſpiration. He then ſeparates theſe from their effects, and interrogates nature, as it were, relative to the three cauſes which produce them.

He had conceived the idea of a machine, in which

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all that appertained to tranſpiration paſſed outwards, and all belonging to reſpiration inwards; and, in conjunction with citizen Seguin, he accordingly undertook ſome very difficult and laborious experiments, by which he diſcovered, that the loſs of weight in a man, in conſequence of tranſpiration, amounts to 2 lb. 13 oz. that he conſumes 33 ounces of VITAL AIR in 24 hours; that he diſengages from his lungs 8 cubical feet of CARBONIC ACID GAS, of which one-third conſiſts of *carbon*, and two-thirds of *oxygen*; that the weight of WATER, which evolves itſelf in the lungs, amounts to 1 lb. 7 oz. of which 2 ounces are *hydrogen*, and 3 *oxygen*; and that 6 ounces of WATER, entirely formed by pulmonary tranſpiration, is diſengaged in the ſame ſpace of time.

He had conſtructed balances, by means of which a demi gros, added to 125 lb. was perceptible; and inſtruments the moſt precious, and expenſive, were eagerly ſupplied by his zeal.

In conſequence of theſe curious and difficult experiments, he had already acquired much information relative to the cauſes of different maladies, and the means of ſeconding the efforts of nature in their cure; nay, he was preparing to attack the ancient and *revered Coloſſus* of *medical errors*. Nothing could have been more important than this undertaking; and it may be fairly ſaid, that if the ſciences have ſuffered an irreparable loſs, *humanity* alſo ought to bemoan the death of Lavoiſier.

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The reputation acquired by the labours we have juſt mentioned, cauſed him to be ſelected by the academy of ſciences, in execution of the decree of the 27th of September, 1791, as one of the members of the bureau de conſultation, (committee of conſultation). He aſſiſted at their ſittings with his uſual aſſiduity; he contributed greatly to enlighten the members on the merits of the diſcoveries laid before them, and in the claims of the various artiſts, which they were to recompence. He was alſo entruſted with other important functions, viz. that of ſuperintending the experiments and inquiries decreed by the national convention, in order to contribute to the means of perfecting *aſſignats*, and alſo that of rendering the forgery of them more difficult.

Political arithmetic, or, in other words, the details of population, conſumption, productions, and agriculture, occupied much of the attention of this excellent citizen. Between 1778 and 1785, he himſelf cauſed two hundred and forty French acres (*meſure des eaux et forêts*) to be cultivated under his own immediate direction in the *Vendemois*, on purpoſe to exhibit uſeful examples to the inhabitants of the country. He produced three ſeptiers * on the ſame quantity of land that had before yielded but two. And at the end of nine years he had doubled the produce.

* A ſeptier is about twelve buſhels Engliſh meaſure.

In 1791 he was nominated a commiſſioner of the national treaſury: this was a loſs to the ſciences; but no perſon was better adapted than himſelf to fulfil the difficult and important functions of his new office, on account of his extenſive knowledge. Without ceaſing to purſue his former ſtudies, he eſtabliſhed ſuch order and regularity in the public accounts, that the receipts and expenditure of all the national offices during the day, might have been known in the courſe of the ſame evening.

The grand and important labour relative to the new *meaſures* about to be eſtabliſhed throughout the republic had occupied the academy ever ſince 1790; but no one had taken more pains, or been ſo uſeful on this occaſion, as Lavoiſier.

The dilatation of metals by heat was an important ſubject not ſufficiently attended to. He therefore cauſed an *apparatus* to be conſtructed in the garden of the arſenal, by means of which metal rules plunged into water, and ſubjected to different degrees of heat, gave motion to a glaſs, that marked on a diſtant object the different degrees of dilatation; and when, in 1793, it was intended to meaſure a baſe for a new meridian, with a preciſion until then unknown, he placed graduated rules of platina and braſs in his own garden: theſe formed ſo many metallic thermometers, by means of which the immediate effect of each degree of heat was inſtantly diſcernible, without having recourſe to a ſeparate thermometer.

Lavoiſier

Lavoisier succeeded Buffon and Tillet as treasurer of the academy, and he was not only serviceable to it, but also to the academicians, by his activity and credit. He introduced new regulations into the accounts, and also into the inventory of the cabinets; and he converted the unemployed funds possessed by the academy, to the advantage of the sciences. In short, Lavoisier was present every where; he was the man whose countenance was deemed necessary on all occasions, and he was adapted to every thing, on account of his activity and his zeal, which were alike admirable.

A man so rare and so extraordinary ought to have enjoyed the respect of the most ignorant, and even the most wicked. To produce the contrary, it was necessary that power should fall into the hands of a ferocious monster, who did not respect any one, and whose blind and sanguinary ambition sacrificed every thing to the desire of pleasing the people. It was supposed, that the immolation of the farmers-general would give them satisfaction. Pretexts were accordingly sought for in order to cut them off. It was on the 19th *Floreal* (8th May, 1794) that twenty-eight farmers-general were assassinated by a mock tribunal of executioners, whose decisions had nothing of justice in them but the name.

For his own justification, and that of his colleagues, Lavoisier had drawn up such a satisfactory memorial, that it was impossible to foresee that crime itself could go beyond the invasion of their fortune.

fortune. Lavoisier observed a few days before his death, that he foresaw they would despoil him of all his property, but that he would earn a livelihood by his labours; and it appeared to me, that the station of an apothecary was that which he would have preferred, as being most analogous to his attainments and reputation.

At the moment they were occupied about this pretended judgment, a paper drawn up by citizen Hall, of the office of consultation, was presented to the tribunal, and in this there was a description of the works, and a recapitulation of the merits, of Lavoisier, capable of making an impression on the most hardened of mortals; but it could make no impression upon these blind, stupid, and ferocious instruments of cruelty and murder; accordingly there perished on the scaffold the greatest man that France ever saw.

In 1771 he espoused Marie-Anne-Pierrette Paulze, daughter of a farmer-general, whose good nature and accomplishments formed the delight of his life, who seconded him in his labours, and who even engraved the figures in his work. This woman, so worthy of exciting interest, beheld her father, her husband, and most intimate friends, all assassinated in the course of the same day. Imprisoned herself, and even menaced with a similar fate, her courage rose superior to all the horrors of her situation; she escaped these inhuman butchers, but she was only deserving of more pity on this very

account,

account, becaufe fhe was calculated by nature to receive a deeper impreffion from the atrocity of the crimes with which fhe was affailed and felt the ftab.

Lavoifier was tall, and poffeffed a benignant countenance, which befpoke genius. His character was mild, humane, fociable, obliging, and he evinced an incredible degree of activity. His credit, his fortune, his reputation, and his office in the treafury, gave him great preponderance, but the only ufe he made of it was to do the greateft good; but this, however, did not prevent his meeting his end from the hand of the executioner, which he bore with all the fortitude imaginable.

SECT. XXI.

OF OXYGEN AIR AS A MEDICINE

JOHN HUNTER, as we have juft feen, by the acutenefs of his genius, had hit upon the *true doctrines* of PHYSIOLOGY; neverthelefs it is but juftice to the modern pneumatic philofophers to remark, that the extracts that have been given from his works are like a rich vein of gold depurated from much drofs, or opinions, which fhew how fhort the human reafon may fall, when trying to penetrate into fubjects without the proper data; for, unfortunately for fcience, John Hunter was, to ufe the vulgar phrafe, no chemift, or in other words, he was a very bad one; hence his opinions, although he lived in the time of Dr. Prieftley, and after his difcovery of vital air, are often contradictory. He, however, ftill poffeffes the greateft merit, and his fection on the life of the blood will redound eternally to his honour.

After phyfiology had received all the advantage that could be derived from the greateft proficiency in anatomy, and the efforts of a great but uninftructed mind *, chemiftry lent her aid,

* John Hunter ufed often to fay, he never read, in order that all his works might have the merit, and they certainly have the air, of originality.

and

and we arrive now at the moſt brilliant æra in medicine.

The firſt opportunity I had, ſays Fourcroy, of paying attention to the energetic action of oxygen belongs to one of thoſe extraordinary circumſtances in ſenſation which is experienced when one is expoſed, for the firſt time, to the ſudden operation of certain chemical preparations which are acrid, and as yet unknown. It was in the year 1787, in preparing a quantity of oxygenated muriatic acid for my lectures, two of my pupils, who were occupied in my laboratory in making this preparation, having received a great quantity of this oxygenated muriatic acid gas in the throat and trachea, were immediately ſeized with a violent and ſuffocating cough. After many convulſive efforts of the diaphragm, they expectorated a matter as thick as the white of an egg half boiled, and which was of a yellowiſh white colour, with a greeniſh tint. This expectoration continued in great quantity until the cheſt was unloaded, which did not happen until after they had ſuffered ſome hours of uneaſineſs. They complained at firſt of an extraordinary dryneſs and tightneſs in the throat and noſe. The *velum pendulum palati* felt to them as if it had become ſolid, ligneous, and very difficult of being moved; their noſtrils felt as if lined with a dry and ſtiff parchment, and the mucus which was ſecreted was exceedingly thick; the eyes were red and watery, and the whole face glowed with heat. Some hours

afterwards the eyelids were glued together, and the tears became thick.

In order to aſcertain with accuracy the effects of this gas, I impregnated ſome animal fluids with it, ſuch as the white of an egg, the ſerum of the blood, and ſaliva; all of which, I obſerved, became thick and coagulated by this gas, in the ſame manner as they do by means of the liquid oxygenated muriatic acid. In proportion as this coagulation took place, the acid gradually loſt its character of oxygenation, paſſed into the ſtate of ſimple muriatic acid, and every thing proved that the oxygen was taken from it by the animal ſubſtance.

To this firſt and poſitive information concerning the thickening or coagulation of our fluids by means of oxygen I added ſeveral other facts in the years 1789 and 1790, during which time I gave, continues Fourcroy, a very long courſe of ſixty lectures, at the Lyceum, on animal matter. It was, in fact, during theſe reſearches that I conceived, and began to execute, the plan of inveſtigations which I have ſince ſent to learned ſocieties. It was then that the immediate thickening and true coagulation of the white of an egg, and the ſerum of the blood, by means of the red oxyd of mercury, while that metal was almoſt reduced to its metallic ſtate by the operation, was diſcovered. This effect was to me a ray of light; it explained to me how the thickneſs and ſoapy quality of animal fluids were owing to the tendency which they had to abſord air and be unit-

ed with oxygen; how eggs which had been immersed for a long time in air were sooner hardened than others; and how, in general, all animal fluids were bleached and grew thick on being exposed to the air.

Soon afterwards the examination which Vauquelin and I made of the tears and nasal mucus, enlarged my views of the power and action of the oxygen of atmospherical air on the fluids of animals, which, by their situation and laws of excretion, were exposed to the contact of air. The lachrymal fluid exhibited to us, under similar circumstances to that in which it is placed by nature, a viscosity, which increases from that which is a little ropy to that which forms the white or yellow concretions which cement the eyelids, or which envelope the *carunculæ lachrymales*, after having moistened their surface. After this fluid has descended into the cavities of the nose, and has been united to the mucus there, which it appears destined to dilute, and to detach from Schneider's membrane, I have seen it, in its mixture with this mucus, exhibit a more rapid progress towards concrescence and the formation of an opake solid substance, of the consistency of a jelly or of glue, owing to the constant absorption of atmospherical oxygen. The animal matter which undergoes this change during its oxygenation has an attraction for this principle, which is equal to that portion of animal fluid which is impregnated with soda, which it exercises at the same time upon the

 quantity

quantity of carbonic acid which is mixed with the air that iſſues from the lungs. Hence this laſt is always found in the ſtate of carbonate of ſoda, in the fluid of the noſe; while, on the other hand, it is in a cauſtic or pure ſtate in our tears. The oxygenation of animal mucus is a little doubtful in this caſe as the ſaturation of ſoda which accompanies it. It can only take place by means of the contact of air. During ſleep the tears flow like a fine fluid along the margin of the eyelids, while, on the other hand, during our waking hours they acquire a ſlight conſiſtency, which cauſes them to be ſpread like a tranſparent membrane on the cornea and ſclerotic coats of the eye.

The example of ſaliva, and the facts relating to it, are neither leſs ſtriking nor leſs favourable to my ideas, nor leſs uſeful, in order that their immediate application to phyſiology may be known. It is another liquid on which oxygen has the greateſt influence, and which appears deſtined to be impregnated with it, in order to tranſport it to the alimentary canal: all the ſources from which this fluid flows being open in that cavity which forms a communication between the air and the lungs, and which conſtantly compreſſes and mixes this fluid with the others which moiſten the inſide of the mouth; and, beſides this, being diſpoſed, by its mucous nature, to retain between its particles thoſe of the air, it becomes charged with theſe in every poſſible degree; and hence the fact announced ſome years ago by Citizen

Citizen Michel Dutennetas, relatively to the oxydation of gold and ſilver triturated in a glaſs mortar with ſaliva, as well as the cuſtom which takes place in ſome laboratories, of haſtening the oxygenation of quickſilver in hog's lard, by ſpitting from time to time in the veſſel in which this tedious proceſs is carried on. I am alſo perſuaded that in the proceſs recommended by Chiarenti of Piſa, for introducing medicines into the ſyſtem by means of the cutaneous abſorbents, the ſaliva not only ſerves as a vehicle, but has alſo a conſiderable influence on their medicinal properties, in conſequence of the oxygen which it yields to the combination that is formed.

From theſe combinations, which ariſe from the abſorption of oxygen by animal fluids, of oxygen which quits ſeveral compound ſubſtances to unite with theſe fluids; from the effect of the thickening or coagulation which takes place in theſe liquors from their intimate union with oxygen, it appears natural to apply the principle to a medical phenomenon, entered in the regiſter of the ſchool of Cos, and confirmed by the obſervations of all ages, and of every man acquainted with the art. I allude to what is called *concoction* in diſeaſes, a conſtant change which announces and accompanies their happy termination. This concoction conſiſts in an equal and homogeneous thickening of ſome fluid; an effect which it is impoſſible not to acknowledge as reſulting from the *fixation* of oxygen, and which is ſimilar to all the combinations I have already enumerated.

 The

The formation of *pus* belongs to the ſame claſs, and obeys the ſame laws.

Every thing then conſpires to ſhew that, from the facts which I have collected, one of the principal means by which the oxygen of medicines acts, depends on its combination with animal matters, and on the thickening which it produces in the fluids, either immediately and in proportion as it combines with them, or mediately by the diſpoſition to coagulate, which it communicates to them while it only ſlightly adheres to them. It is, doubtleſs, from this ſource that we are to refer the concreſcibility and plaſtic property which is obſervable in the fluids of thoſe animals which, breathing by means of pulmonary organs more or leſs extenſive, appear to have a thouſand mouths open, in order to abſorb atmoſpherical oxygen. It is alſo this effect to which we muſt attribute the ſudden change that occurs in the ſerous humours of atonic ulcers upon the application of oxygenated matters, which change is generally followed by a diminution and thickening of the diſcharge. This firſt effect is for the moſt part immediately followed by cicatrization, as appears in the natural progreſs of ulcers, which, at the period when they are about to heal, are covered with a thick gluey pus, inſtead of the ichor which was obſervable until then. It would be difficult to conceive this abſorption and combination of oxygen without obſerving, at the ſame time, the ſource of a change in the nature of the animal ſubſtances in

which

which it is fixed, and without admitting that the proportion of their conftituent principles fuffers a greater or lefs remarkable variation, fimilar to that which is always manifefted in thofe chemical experiments in which fuch fubftances are acted on by matters which are powerfully oxygenated. This variation, which doubtlefs is not quite fo great in thefe medicinal effects as in chemical experiments, is, however, fimilar in its nature, and confifts particularly in the feparation of a portion of hydrogen which is difengaged or combines with water, as well as in the developement of a certain proportion of carbon which is alfo extricated.

But thefe chemical actions of oxygen, which affift in explaining its medical effects, are not the only ones which it appears to exert on the animal body; for this, not being folely expofed to chemical agency, muft experience medicinal power from other changes. Thofe things which are commonly denominated organic forces or powers, becaufe they are inherent in living organs; mufcular mobility, which, by its obedience to different ftimuli, fupports motion and prefides over life, certainly receives a modification from medicinal oxygen. It is now upwards of twenty-five years fince Carminati remarked, for the firft time, that animals, fuffocated by what was then called fixed air, and which were immediately opened after death, had their hearts fo paralyzed and infenfible as not to be irritated by the ftrongeft ftimuli. It was concluded, at that time, that

that fixed air acted like a narcotic poison, and it has required near twenty years labour and research, before Godwin and Humbolt discovered that the heart lost its irritability and contractility, because the blood which touched it was not endowed with the stimulating power, and that the presence of oxygen in the air could support it. Besides, it has been proved that oxygen gas, breathed pure, augments the heat and vital energy, and that the arterial pulsations and muscular contractions become more violent by doing so. Citizen Van Mons has experienced on himself that the suroxygenated muriate of potash produced an exciting and stimulating effect on all his system to such a degree, that the skin became redder and more animated, his pulse more frequent, and his mind more active. These different effects are certainly very remarkable in the administration of remedies, of which the oxygen is separated in our body, and of which it is probable that oxygen is the only primitive agent, as I have elsewhere endeavoured to prove *.

It was impossible, in this enlightened age, that the nature of the atmosphere should have been discovered, and its separation into two airs, without these discoveries leading to views beyond physiology, and we are conducted, as the reader will find, into a new æra of medicine.

* Vide Vol. V. Sect. XXXVIII. on the medicinal power of oxygen.

The different factitious airs were put to the test at the Hotel Dieu in Paris, many of which proved successful, but some turning out inauspicious *, and the revolution succeeding, with the tyranny of Robiespierre, who put to death Lavoisier, and many other literary characters, a veil was drawn over this new branch of science for a time, but as Fourcroy justly observes, " the analogy of " action which has been discovered between diges- " tion, respiration, circulation, and insensible per- " spiration, has begun to establish on new views, " more solid than were heretofore possessed, a sys- " tem of *animal physics*, which promise an abundant " harvest of discoveries and improvements. Un- " questionably it will be, in pursuing the chemical " changes that are undergone in the system, that an " *edifice* equally novel and solid will be erected. " Every thing is ready for this ground-work; seve- " ral philosophers pursue this unbeaten path of ex- " perience; fresh ardour, springing from these new " conceptions, animates those who are engaged in

* It is remarkable, that the first trial of the vital air was made in consumption in France; it gave temporary benefit, and spread, as Chaptal says, " Flowers over the borders of the tomb," but hastening on the mournful event it was soon abandoned, and had not the ingenious Dr. Beddoes, with his coadjutors, Dr. Darwin, Dr. Ewart, Dr. Thornton, &c. been conducted by a rational theory, which they have confirmed by practice, the aerial remedies had probably met with the same fate as transfusion.

" this

" this branch of phyfics; and the track they have
" juft begun to explore appears fuch as muft lead
" them to more precious and accurate refults, than
" any that have hitherto been advanced on the
" functions which conftitute animal life."

Whilft the progrefs of the pneumatic practice of phyfic was in fome meafure ftopped in France by the revolution, Dr. Beddoes, the celebrated profeffor of chemiftry at Oxford, endeavoured to turn the attention of the faculty in England to this new branch of fcience. His works foon paffed into the hands of every one: for he poffeffed the rare art of diffufing through his writings that lively intereft, that enchanting colouring, and that delicate and vigorous touch, which influence, attach, and fubdue the mind. The profundity of his reafoning is every where united to all that agreeable imagery, which the moft brilliant imagination can furnifh. The facred fire of genius animates all his productions; his theories conftantly exhibit the moft fublime profpects in their totality, and the moft perfect correfpondence in their parts; and even whilft he raifes *hypothefes*, we are inclined to perfuade ourfelves that they are eftablifhed truths.

The higheft commendation is certainly due to this ingenious philofopher for his chemical inveftigation of difeafes. But the novelty of the attempt foon expofed him to the malignity of fome not equally well difpofed, and the ardour of purfuit was branded with the name of enthufiafm; but a virtuous

tuous mind, intent on a generous action, looks upon these as so many steps to distinction; for to be either very good or very great, is to be very much envied, and very much misrepresented. Even some who differ with this gentleman in political sentiments sided with the envious and interested against the *pneumatic remedies:* as monks formerly denied the Newtonian philosophy, only because Newton was a protestant. It is a great misfortune, says Dr. Priestley, "when philosophers forsake their pursuits of "nature, which are ever regular and uniform, to "engage in the confusion of political contests."— And who is there but must not regret the flight from this country of the author of this very remark, which some years ago he made to the illustrious Franklin? And philosophy droops her head, since Lavoisier was guillotined. . . . . . . He requested but three days to finish an important experiment he had begun, and the stern tyrant * replied, "France "has no need of philosophers, but of patriots;" and ordered him instantly to execution.—But Dr. Beddoes may perhaps reply, "Homo sum, et hu-"mani nihil a me alienum puto,"—to which I confess I should be at a loss what to answer!—His theories

* Robiespierre.

† Dr. Beddoes has published an attack on Mr. Pitt, an account of the gagging bill, &c. Even the author of this work, burning with zeal to serve mankind, laid aside for a few months medical enquiries, and formed his Political Extracts in three volumes octavo, published by the booksellers

theories of diſeaſes * will no doubt one day or other conſpire, with future diſcoveries in chemiſtry, to unravel the whole of their myſterious operations: and ingenious phyſicians, having learnt to manage their intricate and multifarious machinery, may ſee that art, which can reſt firmly upon no other foundation than a juſt theory of the functions of the body, riſing under their hands into a beautiful and ſolid *ſtructure*. "Nor," ſays Dr. Beddoes, "how-
"ever remote medicine may at preſent be from
"ſuch perfection, do I ſee any reaſon to doubt
"that, by taking advantage of various and conti-
"nual acceſſions as they accrue to ſcience, the ſame
"power will be acquired over living, as it is at pre-
"ſent exerciſed over inanimate bodies; and that
"not only the cure and prevention of diſeaſes, but
"the art of protracting the faireſt ſeaſon of life, and
"rendering health more vigorous, will one day half
"realize the dream of alchemy."

The celebrated Dr. Darwin, who has of late turned his attention much to this ſubject, obſerves,
"that *vital air* penetrates the fine moiſt membranes
"of the air-veſſels of the lungs, and unites with the
"blood by chemical attraction, as is ſeen to hap-
"pen, when blood is drawn into a baſon, for the

ſellers named in the title page of this work. He has however finally relinquiſhed *politics* for the contemplation of medicine and of nature.

* Vide Obſervations on the Nature and Cure of Calculus, Sea Scurvy, Putrid Fever, &c.

"Power

" lower ſurface of the craſſimentum is of a dark red
" ſo long as it is covered from the air by the upper
" ſurface, but becomes florid in a ſhort time on its
" being expoſed to the atmoſphere. The perpe-
" tual neceſſity of the mixture of *vital air* with the
" blood in the lungs, evinces that it muſt act as a
" ſtimulus to the ſanguiferous ſyſtem, as the mo-
" tions of the heart and arteries preſently ceaſe,
" where animals are immerſed in air which poſſeſſes
" no oxygen.—It may alſo ſubſequently anſwer an-
" other important purpoſe, as it probably affords
" the *material* for the production of the *ſenſorial*
" *power*; which is ſuppoſed to be ſecreted in the
" brain and medullary part of the nerves; and that
" the perpetual demand of this fluid in reſpiration
" is occaſioned by the *ſenſorial power*, which is ſup-
" poſed to be produced from it, being too ſubtle to
" be confined in any part of the ſyſtem *."

The late celebrated Dr. Withering of Birmingham, in a letter to Dr. Duncan, has the following obſervations with reſpect to pneumatic medicine. " With us, pneumatic medicine is advancing; " hydrocarbonate and oxygen are the two airs " that have moſtly been uſed; and theſe ſhould be " diluted with eighteen or twenty times their bulk " of atmoſpheric air. The former weakens the " ſtroke of the pulſe, occaſions vertigo, and ſome-

* Vide Zoonomia, or the Laws of Organic Life, Vol II. A work which occupied, as this philoſopher ſays, thirty years deep meditation.

" times

" times excites naufea. It produces a difpofition " to fleep, abates the cough, and eafes the refpira- " tion in fome afthmatic affections; but in active " hemoptoe, it effects a cure more fpeedily, and " more pleafantly, than I have feen done by any " other means. Oxygen, on the contrary, excites " the action of the arterial fyftem, warms the ex- " tremities, and feems to invigorate the vital prin- " ciple without exhaufting it. From thefe laft " circumftances, you will at once conceive it ap- " plicable to a very extenfive clafs of difeafes. I " have lately ufed it with advantage in two cafes of " melancholy; and I have feen it remove the pa- " ralyfis of lead, which had been treated to little " purpofe, by the other more ufual means."

The Rev. Mr. Townfend, the learned author of a fyftem of Therapeutics, obferves, when fpeaking of the different *factitious airs*, " that thefe promife, " under the fkilful management of Dr. Beddoes at " the Hot Wells, Briftol, and Dr. Thornton in " London, to be a remedy well worthy the atten- " tion of the medical practitioner. The *vital air*, " properly diluted with common air, is a ftimulus " the moft natural and diffufive. It promotes the " infenfible perfpiration, greatly aids digeftion, fa- " vours fleep, exhilarates the fpirits, and relieves " difficult refpiration. It is found of the higheft " advantage in moft nervous difeafes. The *azotic* " *air* abates inflammation, and is the only remedy " with the *hydrogen air*, that is found capable of

" arrefting

" arresting the progress of consumption, and the " *carbonic acid air* is a most powerful antiseptic."

It being ascertained by direct experiment, that the heart and arteries can be *raised* from 64 to 120 pulsations in a minute, by the inhalation of pure *oxygen*, or *vital air*, and that by abstracting this *vital gas*, from atmospheric air, their actions can be *lessened* from 120 to 64 beats in a minute, the *pneumato-chemical* physician has therefore a complete power over the heart and arteries, just as a watch-maker has a power over the movement of a watch by means of the regulator. It being likewise proved, that the blood and solids are composed in part of *vital air*, he has also the power of altering the mass of blood, and therefore of changing the constitution. He possesses in the *vital air* a means of unlocking obstructed vessels, promoting the insensible perspiration, quickening the digestion, increasing the animal heat and muscular powers, and of raising the spirits. He can render the respiration easy, and give bloom to the complexion *.

To conclude.—The *pneumatic doctrine of physic* has met with a welcome reception, not only among the learned of our own country, but in foreign parts. Dr. Rush has endeavoured to apply it to the explanation of some appearances exhibited in the late destructive fever at Philadelphia. In other

* These positions have been proved in the different sections of this volume, and may be found in Dr. Beddoes' considerations, having been confirmed by Dr. Thornton and others in their letters to Dr. Beddoes, passim.

parts of America phyficians of the greateft celebrity have fpoken in favourable terms of this inveftigation. Dr Garnet, who is gone from this country, with an appointment of Glafgow profeffor of experimental and natural philofophy, is deeply engaged in unfolding the nature of eruptive difeafes upon the new doctrines. In India this inveftigation has proceeded with rapidity, and has been ably applied by Dr. Briggs in illuftrating the caufe of hepatic affections. At Vienna, where the fubject was early introduced by a letter from Dr. Ingenhouz to Dr. Scherer, it has been warmly taken up. Spain, which can boaft of medical men of the moft enlarged views, has adopted meafures ftill more decifive. The Englifh tracts, in which the ufe of airs in medicine is recommended, have, I am informed, been tranflated by order of government; and what is more to the purpofe, I certainly know that a fmall *pneumatic hofpital* has been eftablifhed at Madrid. In Pruffia it has been purfued by Dr. Acard. A pneumatic hofpital is erected and eftablifhed at Briftol under the conduct of the enlightened and philanthropic Dr. Beddoes. In fhort, the *anti-pneumatifts*, if I may fo denominate thofe who are eager to ftifle the inquiry, whatever be their local vogue, will principally be found among phyficians, or apothecaries, neither liberal in their conceptions, nor converfant in that great branch of natural philofophy, which unfolds the properties of *permanently elaftic fluids*.

SECT.

SECT. XXII.

OF OXYGEN AS RELATED TO IRRITABILITY.

DR. BEDDOES ſuſpeƈts oxygen to be the principle of irritability, but if philoſophers have not gone ſo far as to ſhew what the *irritable principle* is, they have diſcovered, at leaſt, the *condition* of its *exiſtence.*

They obſerve firſt, " *that every thing that increaſes the quantity of* oxygen *in organized bodies, increaſes at the ſame time their irritability.*"

A conſiderable quantity of very pure *oxygen air* was injeƈted into the jugular vein of a dog. Upon opening the thorax and the pericardium of the animal, the heart was found *more irritable* than ordinary, and its alternate contraƈtions and dilatations continued upwards of an hour.

The *right auricle* of the heart was vermilion, and it contained, as well as the *right ventricle,* a great quantity of blood of a bright vermilion colour. The blood contained in the *left auricle,* in the *left ventricle,* the *aorta,* and the *arteries,* was of a bright roſe colour, and mixed with bubbles of air.

All the muſcles were *more irritable* than ordinary.

After the blood contained in the heart and arteries was diſcharged, the *irritability* of the heart and muſcles was ſenſibly diminiſhed.

 This

This experiment proves, moſt deciſively, that the *vermilion* colour which the blood aſſumes in paſſing through the lungs is not owing to *the loſs* of *charcoal* and *hydrogen*; but that it proceeds from *the combination* of the blood with the *oxygen air.*

In the experiment I have juſt now deſcribed, the livid colour of the venous blood in the *right auricle* and *ventricle* of the heart was changed to that of vermilion. Nevertheleſs it could not have *loſt* any *carbon* or *hydrogen:* it therefore only *acquired oxygen* or *vital gas.*

This experiment is alſo a direct proof that *oxygen* favours *the principle of irritability*; for by *ſurcharging* the blood with *oxygen*, by *hyper-oxygenating* it, if I may uſe the expreſſion, the *irritability* of the contractile fibre was, as we have ſeen, conſiderably *increaſed.*

The *irritability* alſo of perſons made to breathe *oxygen air* is wonderfully increaſed, as is ſhewn by an univerſal increaſe of energy in the ſyſtem. But what ſhews moſt clearly, that the *irritability* is always *in proportion* to the quantity of *oxygen* in the ſyſtem, are the phænomena attending the action of *mercury* and *mercurial oxyds* upon animals. As this is one of the moſt ſtriking proofs of this theory, and as many perſons, and amongſt the reſt, philoſophers of the firſt rank, ſuch as Dr. Crawford, have been ſtruck with the novelty and ſimplicity of my mode of explaining theſe phænomena, I cannot forbear,

forbear, ſays he, entering into ſome detail upon this ſubject.

It is a well known fact among phyſicians, that *mercury*, in its *metallic ſtate*, has *no effect* upon the human body. I have known many people, who for many years have taken a daily portion of quickſilver, to the amount of one or two ounces, but who never perceived any effect whatever from this ſingular and ridiculous cuſtom. It is proved alſo by the experiments of Dr. Saunders, that the effects of mercurial ointment are owing only to the ſmall quantity of mercury that has been *oxydated* during a long trituration. It is neceſſary, therefore, that mercury ſhould be oxydated, to have any effect on the human body. Beſides, it is well known that in perſons who have rubbed themſelves with mercurial ointment, or who have taken the oxyd of mercury, the *mercury*, after having *produced* its uſual effects, has paſſed through the ſkin in a *metallic form*, and has amalgamated itſelf with watches, and the gold in the pocket, &c. The oxyd of mercury, in paſſing through the human body, parts with its *oxygen*, and it is this *oxygen* alone, which remains combined with the ſyſtem, that *the effect* produced by *oxydated mercury* is owing. Thus *arſenic*, under its metallic form, has no effect upon animals; but the *white oxyd* of this metal is one of the moſt terrible poiſons; for it *hyper-oxygenates* the organized fibre with which it comes into contact, and reaſſumes its metallic form.

The cauſe of the beneficial effects of *ſteel* on the animal œconomy has not been hitherto ſufficiently ſcrutinized. According to Monſ. Chaptal, the red particles of blood almoſt wholly conſiſt of *iron.* And it is well known that the blood acquires its florid colour from its expoſure to the air in the veſicles of the lungs, from whence nothing but *vital air* is abſorbed. It ſeems therefore probable, that the red particles of blood conſiſt chiefly of particles of iron, calcined by the *oxygen*, or *vital air*, and reduced to the ſtate of a red oxyd of iron. Hence it appears, that *chalybeates* will not only increaſe the quantity of red particles in the blood on which the ſtimulant and tonic powers of that fluid moſt probably in a great meaſure depend, but will enable it to decompoſe a larger quantity of air which is received in the lungs by reſpiration, and thus occaſion a greater evolution of heat, and will produce the ſame effect upon the ſyſtem, as if a much purer atmoſphere had been breathed for ſome time *.

By various experiments of Dr. Hale's, compared with thoſe of Dr. Ingenhouz, it is evident, ſays the celebrated author of a ſyſtem of Therapeutics, that vegetables in ſummer, while they enjoy the ſun, are inceſſantly decompoſing water, and emitting from their leaves their *oxygen* combined with *caloric* in the form of *vital air.* And it is clear, that as long as

* This conſideration is taken up more at large in Vol. V. Sect. XXXVIII. and XXXIX. on the medical power of oxygen.

water

water is ſupplied abundantly, they not only preſerve their vigour, even at mid-day with the moſt fervent heat, as in the ſouth of Spain, but make a rapid progreſs in their growth, and emit a proportionable quantity of *vital air*. May we not infer from thence, *that their irritability depends on* oxygen, *and their vital energy on a plentiful ſupply of this reviving element*, whilſt the *hydrogen* of the water not only ſupplies the combuſtible part of vegetables, but, by depoſiting its caloric, maintains the vital heat.

Were theſe facts well aſcertained, it would throw great light upon the operation of theſe medicines in the human frame, and contribute to eſtabliſh the ſyſtem, now received by many, reſpecting *irritability* as induced by *oxygen*.

2. "*Whatever diminiſhes the quantity of* oxygen *in organized bodies, diminiſhes at the ſame time their irritability.*"

A ſmall quantity of *azotic air* was injected into the jugular vein of a dog. The animal died in twenty ſeconds. Upon opening the thorax, the pericardium, and the heart,—*the right auricle* and *ventricle* were filled with black blood. The *left ventricle* was of its ordinary colour. The heart, and almoſt all the muſcles, had *loſt* their *irritability* almoſt entirely; they contracted but weakly upon the application of the ſtrongeſt ſtimuli, ſuch as ſulphuric æther, and the electric ſpark.

When conſumptive patients breathe *azotic* or *hydrogen air*, blended with a ſmall portion of *common*

air, the circulation, irritability, ſenſibility, and appetite, is diminiſhed, and the hectic fever is abated *.

There was long ſince a diſpute between Dr. Whytt and Baron de Haller reſpecting *irritability*, and that diſpute is not yet completely ſettled. The *former* attributed this power wholly to the *nerves*; the *latter* to the *muſcular fibre*, independent of the nerves.

But were we permitted to reaſon from analogy, we might ſuſpect, if not conclude, that ſince *plants*, by irritability alone, without brain or nerves, exerciſe the vital functions; theſe likewiſe may in animals depend on the irritability of the muſcular fibre, whilſt ſenſation, thought, and voluntary motion, reſult undoubtedly from the preſence of a brain.

The womb, in the time of pregnancy, increaſes in ſubſtance and ſize probably fifty times beyond what it naturally is, and this increaſe is made up of living animal matter, which is capable of action within itſelf. I think we may ſuppoſe its action more than double; for the action of every individual part of this viſcus, at this period, is much increaſed, even beyond its increaſe of ſize; and yet we find that *the nerves* of this part *are not* in *the ſmalleſt degree increaſed*. This ſhews that the nerves and brain have very little to do with the actions of a part:

* Vide Obſervations on the Medicinal Uſe of the Factitious Airs, by Dr. Beddoes; alſo the Letters of Dr. Thornton, Dr. Ewart, Dr. Peart, &c. to the ſame.

while

while the veſſels, whoſe uſes are evident, increaſe in proportion to the increaſed ſize: if the ſame had taken place with the nerves, we ſhould have reaſoned from analogy!

If nerves, either of themſelves, or from their connexion with the brain, gave vitality to our ſolids, how ſhould a ſolid continue irritable, after a nerve is deſtroyed, or paralytic? for the part continues to be nouriſhed, although not to the full health of voluntary action; and this nouriſhment is the *blood*, for deprive it of the blood, and it mortifies.

This opinion is countenanced by the experiments of Baron de Haller; ſome of which are recorded in one of the early volumes of the Philoſophical Tranſactions, for it appears that a *paralyſis* of the poſterior extremities of animals was induced by tying their aorta.

The learned Dr. Monro, who was not much inclined to give up the pre-eminence of the brain and nervous ſyſtem to the vaſcular, after many experiments was obliged to conclude, "*that concomitant arteries, ſomehow or other, tune the nerves, ſo as to fit them to convey impreſſions.*"

In order to decide, ſays the ingenious Dr. Fowler, whether a greater detriment to that condition of a limb, upon which contraction depends, is induced by interrupting its circulation, or by intercepting its communication with the brain, I reſolved upon trying the powers of the nervous electricity as diſcovered by Galvani.

Having

Having tied the crural artery on one ſide, and divided the ſciatic nerve on the other, on three full grown frogs, I cut off their heads with a pair of ſciſſars, to preſerve the circulation of the blood as entire as poſſible, and at the ſame time to prevent the continuance of pain, which might exhauſt the power of the body, and defeat the experiment.

When theſe frogs were laid upon a ſurface of zinc, and excited by means of a rod of ſilver, the contractions were found extremely feeble in the legs whoſe artery had been tied, and ceaſed altogether in about twenty-two hours after their death. But in the legs, whoſe nerve had been divided, they appeared very vigorous, and continued excitable upwards of two days after they had ceaſed to be ſo in the other.

Having thus found, that a diminution of the circulation of a part, was accompanied with a proportionable diminution of the reſpective powers of nerves and muſcles in that part, I next proceeded to examine if an increaſed circulation would be attended with a proportionable increaſe of theſe powers; and that this is actually the caſe, the facts I am about to relate will prove.

I have before ſhewn, that if a living and entire frog be ſet upon a plate of zinc, contractions can very ſeldom be produced in any part of its body by paſſing a rod of ſilver over it, ſo that the ſilver, the frog, and the zinc, may be all in contact with each other. But I have found, in upwards of twenty

experiments, that when inflammation had been excited in one of the hind legs of a frog, by irritating it with a brush, contractions uniformly took place in that leg when the metals were applied to it, although none had been produced in it before it was inflamed, nor could still be produced in the other leg which remained in its natural state.

Having previously, continues Dr. Fowler, excited inflammation, by means of a brush, in the foot and leg of a healthy and large frog, I cut off its head. The contractions excited by the different metals in the inflamed leg were in vigorous and instantaneous jerks; those in the sound leg more languid, and difficultly excited. Spontaneous motions continued at this time nearly the same in both. Even till the end of the second day, after the frog's head had been taken off, the contractions excited in the inflamed leg continued uniformly, and beyond all comparison more vigorous than what I could by any means excite in the sound leg. It then became very stiff.

Dr. Fowler, from these experiments, has judiciously concluded, that the *sanguiferous system* contributes more immediately than the *nervous* to the support of *that condition* of muscles and of nerves, on which *depend all the phænomena of contraction in the animal fibre*.

This subject, it must be confessed, is after all exceedingly abstruse, and the ideas of the best physiologists are not so clear and distinct, so complete and comprehensive,

comprehenſive, as we could wiſh: but, as Dr. Beddoes has judiciouſly obſerved,

" *We ſhould ſet a proper value on our preſent know-*
" *ledge, although it be imperfect, and reſtrain thoſe*
" *rude hands, that are ever ready to pluck up the ten-*
" *der plants of ſcience, becauſe they do not bear ripe*
" *fruit at a ſeaſon, when they can only be putting forth*
" *their bloſſoms.*"

PRACTICAL

PRACTICAL OBSERVATIONS.

SECT. XXIII.

OF THE GAZEOUS OXYD OF AZOT.

This new tried gas may be confidered as a more powerful form of OXYGEN GAS, and hence, between the two, we fhall now have at our difpofal an infinite feries of powers.

Dr. BEDDOES.

AT length, fays Dr. Beddoes, after fome difgufts and much delay *, we have it in our power to announce the firft proceedings at an eftablifhment, for applying chemiftry to the elucidation of animal nature,

* The plan was firft publicly propofed by Dr. Beddoes in the year 1794. In 1795 he writes, " more than three years have elapfed fince I laid before the public my reafons for fuppofing that factitious airs might be advantageoufly introduced into the practice of medicine. The facts at that time, afcertained, or believed to be afcertained, were not fufficiently numerous for conclufive reafoning. But the minds of many friends of humanity were filled by thefe fpeculations with the moft pleafing hopes; and the liberality of William Reynolds, of Coal-pit Bank, Jofeph Reynolds, of Ketley, and William

nature, or for purſuing the connexion between the properties of elaſtic fluids, and the conditions of life. By ſuch an inveſtigation, the public has been already too often told how much I conſider it as practicable to advance *phyſiology*, the moſt intereſting of the ſciences, and *medicine*, the moſt uſeful of the arts. Intimately perſuaded that immenſe improvements

William Yonge, of Shefnal, Shropſhire, who each advanced an hundred pounds, enabled me to aſcertain by experiment the practicability of what I had propoſed. The project could not be loſt upon an inquiſitive age. By the ignorant [illegible] who hardly want the temptation of intereſt to vilify what they [illegible] not underſtand, the deſign is indeed decried or rid[illegible] But it has been moſt effectually ſupported by uſeful ſuggeſtions and accurate obſervations from various practitioners of medicine. No perſon ingenuous enough [illegible] examine evidence before he pronounces, can now doubt of the ſafety of this method of treating the ſick; and without the entire rejection of human teſtimony in medicine aſſent cannot conſiſtently be withheld from its efficacy in removing ſome diſeaſes, and permanently relieving the moſt excruciating pains to which human beings are liable.

I preſume not, however, to aſſert that we have data on which we can ſecurely eſtabliſh general inferences. I ſhall be content if it be granted that enough has been done to juſtify further inquiry. The preciſe extent, to which the *pneumatic* practice may be advantageous, remains to be decided by cautious experience; and who, that has any regard for truth and for mankind, but muſt wiſh the moſt effectual meaſures to be taken for arriving at ſuch deciſion?

My own reflections led me to believe that a ſmall appropriated inſtitution would conduce more to this purpoſe in two,

provements muſt, ſooner or later, reſult from the inquiry, provided nature be conſiſtent with herſelf, and nothing doubting the truth of this, the fundamental poſtulate in all philoſophy, I felt little diſcouraged by failures, which the preſumption of ſcioliſts has often buſied itſelf in repreſenting as deciſive. Nor has the intelligent part of the public, I believe, been induced to regard as finiſhed that

two, than occaſional and diſperſed practice in twenty years. Many perſons, eminent for profeſſional or philoſophical knowledge and general good ſenſe, declared it as their opinion, that an adequate ſubſcription might ſpeedily be raiſed, ſince [illegible] even the proſecution of the war—could be more urgent [illegible] health and preſerve life. They knew that the [illegible] muſt contain a number of individuals, ready to redeem [illegible] from hopeleſs diſorders, if by any new means [illegible] effected, even at an unlimited price. They [illegible] individuals would contribute a ſmall ſum for the [illegible] of having a remedy in ſtore in caſe they themſelves or their near relations ſhould be attacked by ſuch diſorders. This expectation was perhaps formed without ſufficient attention to the uſual indifference of mankind to domeſtic good, if it lie at any diſtance: and it was forgotten that thoſe inſtances of national munificence which encouraged our hopes, might be more owing to faſhion or momentary warmth of feeling, than to deliberate philanthropy. Whatever was the cauſe, the attempt to procure contributions has met with inconſiderable ſucceſs. A ſum, not much exceeding 800*l.* has been collected, though moſt of thoſe who can be conſidered as *improvers of medicine*, have publicly teſtified their approbation of the inquiry; and though the liſt of ſubſcribers, if the ſanction of names be regarded, cannot fail to ſatisfy the moſt ſcrupulous examiner."

which

which could not properly be ſaid to be begun. For myſelf, among a multitude of reports, obſerving ſome far more favourable than could be expected from the exceſſive diſproportion between the means hitherto employed, and the end in view, I inceſſantly perſevered in urging the execution of the deſign. How widely this proceeding departed from that *wary profeſſional conduct*, which, above all things, avoids committing itſelf by any meaſure of ſtriking ſingularity, and is content with the eternal repetition of proceſſes, from which nothing of advantage is expected, and nothing gained, I could not be inſenſible. The preſent was, perhaps, the firſt example, ſince the origin of civil ſociety, of an extenſive ſcheme of pure medical inveſtigation. The object, above every other that has been propoſed in the ſame department of knowledge, required, to its attainment, the utmoſt efforts of patient genius. It could not therefore eſcape me that the purſuit might, in its own nature, be highly rational, and yet that thoſe who firſt engaged in it, might never ſtrike into the right path. It was plain that we might even prepare a happier æra for mankind, and yet earn from the maſs of our contemporaries nothing better than the title of *viſionaries* or *enthuſiaſts*. Still it was in poſſibility, (indeed, according to my conceptions, in probability) that our endeavours ſhould ſpeedily approve themſelves by ſome diſcovery, applicable to the relief of the ſick. Encouraged by this reflection, I ſeized every public

and

and private opportunity of advancing the project. But I would not suffer myself to be hurried either by the impatience of some who wished to fix their opinion concerning the medicinal power of gases, or by the reflections of others who (as I am well informed) pronounced with confidence that I should never venture to put them to the proof. Neither did I listen to that well-meaning timidity, which has endeavoured, by maxims ill or well applied, to persuade me that I was too eagerly *forcing* the improvement of medicine. For disease and death would not suspend their operations in compliment to the apathy of the profession, or the public, was clear. And I judged (the event will shew whether I judged rightly), that human reason had attained a degree of strength adequate to the achievement of this most arduous enterprize.

To have engaged in it, however, either without a sufficient fund, or the most able assistance, would have been to do a good cause the most lasting of injuries, supposing (what I have long sincerely believed), that extensive benefit may result from the undertaking. The qualifications of a superintendant were, indeed, of still greater importance than the amount of the subscription. In some hands, the largest sum would have been utterly unproductive. And the acquisition of a properly qualified associate might be considered as more than virtually doubling the fund; since it is the prerogative of superior talents to accomplish great purposes by small means.

 A super-

A ſuperintendant, equal to my wiſhes and ſuperior to my hopes, being at length ſecured, the beſt method of opening the inſtitution became the next object of conſideration. It appeared moſt prudent to wave the uſe of gaſſes for a time, and to confine ourſelves to the adminiſtration of common remedies. Without conciliating that claſs from which we were to draw our patients, we could make no progreſs, and we wiſhed not to exhibit ourſelves, as experimenters animated by that ſpirit of boyiſh wantonneſs, which pays no regard to the faculty of feeling in man. The number of invalid paupers, that have reſorted to us, ſhews that we were not miſtaken in theſe views; and while it afforded an opportunity of trying the effects of digitalis, and other ſubſtances, which we ſuppoſed might poſſeſs ſimilar virtue, on a very extenſive ſcale, in conſumption, and of verifying, perhaps of eſſentially improving, the new treatment of ſyphilis, it conſtantly offered us the choice of patients, who could have no hope from common remedies, and by conſequence might be fit ſubjects for the factitious airs. Meanwhile, there was a chance that among the poſſible medical applications of theſe agents, ſome one would occur as particularly worthy our minuteſt attention.

This has actually happened. The ſpecies of elaſtic fluid, which its great diſcoverer, Dr. Prieſtley, denominated the *dephlogiſticated nitrous air*, and others have ſince called *gazeous oxyd of azot*, is in general not unknown to chemiſts, though they are

unacquainted

unacquainted with its composition, its most extraordinary effects, and probably with its perfect preparation. Piqued by the singular contrast of qualities attributed to this air (and also perhaps, in some measure, by the gratuitous and undoubtedly false opinion of my friend Dr. Mitchill of New York, on contagion), Mr. Davy was led cautiously to respire it a few times in small quantity. Still, however, dissatisfied with the result and venturing upon a larger dose, he exhibited a scene the most extraordinary I had ever witnessed, except in the case of that epileptic patient, whom I have described (*Considerations on Airs*, part iv. p. 13) as agitated, in consequence of the respiration of oxygen gas, with a long succession of the most violent movements. The two spectacles differed, indeed, essentially in one respect. In the former every thing was alarming: in the latter, after the first moments of surprise, it was impossible not to recognise the expressions of the most ecstatic pleasure. I find it entirely out of my power to paint the appearances, such as they exhibited themselves to me. I saw and heard shouting, leaping, running, and other gestures, which may be supposed to be exhibited by a person who gives full loose to feelings, excited by a piece of joyful and unlooked for news. As in the case of the epileptic patient, *no weariness or depression followed:* so in this case, *no exhaustion or languor or uneasy feeling took place.* The experiment Mr. Davy has very frequently repeated, and generally with the highest

pleaſurable ſenſations, and, except under particular circumſtances, with conſiderable muſcular exertion, which have not in any inſtance been ſucceeded by fatigue or ſadneſs.

Since that time, a number of perſons have inhaled the ſame gas. The following is an abſtract of the reports furniſhed by themſelves. The inaccuracies (ſhould any occur) will ſoon be checked by the full account. Imperfections both accounts will have, for it is impoſſible for the combined endeavours of the ſpectator and the ſubject of experiment adequately to repreſent what was ſometimes ſeen and felt.

The individuals mentioned below might be claſſed in various ways. Many had previous apprehenſion. Some had never heard of the expected effect. Others diſbelieved it. A diſtinction ought alſo to be made between thoſe who reſpired before we had learned to prepare the air with certainty, and thoſe who have reſpired it ſince. From many hundreds of experiments, we have alſo now acquired an idea of the doſe, ſuitable to different temperaments. But there was a time, when for want of ſuch knowledge, the reſults were leſs agreeable than might have been wiſhed. All theſe circumſtances require attention. At preſent, however, without attempting any ſtrict arrangement, or analyſis, I ſhall merely endeavour to ſtate the leading circumſtances as briefly as perſpicuity will allow.

Mr.

Mr. J. W. Tobin (after the firſt imperfect trials), when the air was pure, experienced ſometimes ſublime emotions with tranquil geſtures, ſometimes violent muſcular action, with ſenſations indeſcribably exquiſite; no ſubſequent debility—no exhauſtion.—His trials have been very numerous.

Rev. Rochemont Barbauld felt exhilarated, and was compelled to laugh, not by any ludicrous idea, but by an impulſe unconnected with thought, and ſimilar to that which is felt by children full of health and ſpirits.

Mrs. Barbauld—*the children's friend.* At firſt, pleaſurable ſenſations, occaſioning involuntary laughter; ſome faintneſs afterwards.—We now underſtand the regulation of the doſe, ſo as perhaps to have removed Mr. B.'s languor, and to give Mrs. B. the pleaſure without the faintneſs.

Mr. George Burnet had never heard of the effect of the air—after inhalation broke out into the moſt rapturous exclamations I ever witneſſed—breathed at two o'clock P. M. and had all day a moſt delightful flow of ſpirits.

Mrs. Beddoes—very ſtrong pleaſurable ſenſations—inclination for muſcular exertion, could walk much better up Clifton Hill—has frequently ſeemed to be aſcending like a balloon, a feeling which Mr. Burnet ſtrongly expreſſed.

Mr. James Thomſon. Involuntary laughter—thrilling in his toes and fingers—exquiſite ſenſations

of pleaſure—A pain in the back and knees, occaſioned by fatigue the day before, recurred a few minutes afterwards. A ſimilar obſervation we think we have made on others; and we impute it to the undoubted power of the gas to increaſe the ſenſibility, or nervous power, beyond any other agent, and probably in a peculiar manner.

Mr. Thomas Pople—at firſt unpleaſant feelings of tenſion; afterwards agreeable luxurious languor, with ſuſpenſion of muſcular power—laſtly increaſed powers of body and mind—vivid and highly pleaſurable ſenſations. In a ſecond experiment, all the faculties abſorbed in fine pleaſing feelings of exiſtence.

Mr. Stephen Hammick, ſurgeon of the Royal Hoſpital, Plymouth. In a ſmall doſe, yawning and languor.—It ſhould be obſerved, that the firſt ſenſation has often been diſagreeable, as giddineſs; and a few perſons, previouſly apprehenſive, have left off inhaling as ſoon as they felt this.—Two larger doſes produced a glow, unreſtrainable tendency to muſcular action, high ſpirits and more vivid ideas.

A bag of common air was firſt given to Mr. Hammick, and he obſerved that it produced no effect. The ſame precaution againſt the deluſions of imagination was of courſe frequently taken.

Mr. William Clayfield has moſt reſiſted the effects of the gas. Pretty ſtrong doſes produced a tranſitory intoxication. In two inſtances, very large doſes have excited the violent muſcular orgaſm, accompanied

companied with exquisite pleasure, and followed by no debility.

Mr. Robert Southey could not distinguish between the first effects, and an apprehension, of which he was unable to divest himself. His first definite sensations were, a fullness, and dizziness in the head, such as to induce fear of falling. This was succeeded by a laugh, which was involuntary, but highly pleasurable, accompanied with a peculiar thrilling in the extremities—a sensation perfectly new and delightful. For many hours after this experiment, he imagined that his taste and smell were more acute, and is certain that he felt unusually strong and cheerful. In a second experiment, he felt pleasure still superior—and has since poetically remarked, that he supposes "the atmosphere of the "highest of all possible heavens to be composed "of this gas."

——— Wilmot, M. D. Involuntary laughing, with unusual muscular motions, but no particularly pleasant or unpleasant feeling—heat in the chest—heat and perspiration in the feet. On a second inhalation the sensations were pleasurable.

Robert Kinglake, M. D. Additional freedom and power of respiration, succeeded by an almost delirious, but highly pleasurable sensation in the head, which became universal, with increased tone of the muscles. At last, an intoxicating placidity absorbed for five minutes all voluntary power, and left a cheerfulness and alacrity for several hours.

A ſecond ſtronger doſe produced a perfect *trance* for about a minute; then a glow pervaded the ſyſtem. The permanent effects were, an invigorated feeling of vital power, and improved ſpirits.

Mr. Notcutt, formerly lecturer on chemiſtry at Hackney, was twice thrown into an ecſtatic pleaſurable trance—the firſt time his ſpirits were better for the day—after the ſecond, he was languid, but is inclined to impute this to exerciſe in oppreſſively hot weather.

Mr. Wedgwood breathed atmoſpheric air firſt without knowing it was ſo. He declared it produced no effect, which confirmed him in his diſbelief of the power of the gas. After breathing this ſome time, he threw the bag from him, kept breathing on laboriouſly with an open mouth, holding his noſe with his left hand without power to take it away, though aware of the ludicrouſneſs of his ſituation—all his muſcles ſeemed to be thrown into vibratory motion—had a violent inclination to make antic geſtures—ſeemed lighter than the atmoſphere, and as if about to mount. Before the experiment, was a good deal fatigued after a very long ride, of which he permanently loſt all ſenſe. In a ſecond experiment nearly the ſame effects, but with leſs pleaſure. In a third, much greater pleaſure.

Dr. Beddoes, notwithſtanding his apoplectic make, and the firſt effect of this air was frequently that of producing giddineſs, yet from his eager deſire of aſcertaining the effects of theſe new powers,

rising superior to self-considerations, he instituted the same experiments on himself as he had done with the oxygen air. His first sensations, says this great and philanthropic character, had nothing unpleasant; the succeeding have been agreeable beyond his conception or belief, even after the rapturous descriptions he had heard, and the eagerness to repeat the inhalation which he had so often witnessed. He seemed to himself, at the time, to be bathed all over with a bucket full of good humour; and a placid feeling pervaded his whole frame. The heat of the chest was much greater from a small dose than he ever felt from the largest quantity of oxygen. A constant fine glow, which affected the stomach, led him one day to take an inconvenient portion of food, and to try the air afterwards. It very soon removed the sense of distention, and, he supposes, expedited digestion. He has never tried to bring on the high orgasm; but has generally felt more alacrity—and he has not experienced one languid, low, *crapulary* feeling.

Upon the whole, Dr. Beddoes believes that the PNEUMATIC INSTITUTION might offer a fair claim to the premium, anciently proposed for the discovery of a new pleasure; and he ventures to say that the first slight unpleasant sensations about the head may be always obviated by due management *.

* Vide "Notice of some Observations made at the Medical Pneumatic Institution."—In the communication of our full experience, says Dr. Beddoes, neither unnecessary delay, nor reserve,

reſerve, ſhall take place. We propoſe to ſend it abroad along with other matter, in a periodical work, to be entitled "RESEARCHES CONCERNING NATURE AND MAN." After the firſt number, which we hope will appear in leſs than three months, the publication will come out quarterly. We truſt we ſhall never be in want of valuable papers; and we think it better to publiſh at ſtated times, than to wait for a certain accumulation of materials. We ſhall inſert communications, and perhaps occaſionally, tranſlations of important tracts, little known in this country.

A number may ſometimes conſiſt of one or two eſſays only. We cordially diſapprove that ſacrifice of utility to variety, of which periodical publications ſo frequently afford examples. Nor would we on any account foment the preſent baneful taſte for deſultory reading, which is perhaps the greateſt evil that has ariſen from the multiplication of the productions of the preſs.

Dr. Kinglake has promiſed us his able aſſiſtance: and we have other correſpondents, upon whoſe ſupport we can depend. There are few, whoſe impatience to appear in print our numbers will not ſucceed each other quickly enough to ſatisfy The title of our work ſhews that we deſign it for the intelligent out of the profeſſion, as well as in it.

The firſt number will conſiſt of a "paper on the philoſo-
" phy of medicine, by the author of this notice—of part of
" a *vaſt* chemical inveſtigation, connected with the gas ſo
" often mentioned, and including its hiſtory, by Mr. Davy;
" of an account of the caſes in which it ſhall have been
" uſed; of an account of our experience in phthiſical caſes,
" by Dr. Kinglake—together with ſome communications."

SECT.

SECT. XXIV.

OF THE ENEMIES TO PNEUMATIC MEDICINE.

Genus I.

PHYSICIANS MERE COLLECTORS OF FEES, REGARDLESS OF MEDICAL SCIENCE, GIVEN TO ARTIFICE AND INTRIGUE, EACH SPECIES AFTER HIS OWN MANNER.

SPECIES.

1. The *bullying Doctor*, D.

—— Inexorabilis, acer

looks big, ſtruts, ſwaggers, ſwears *.

* Surgeons, in our times, more frequently bear theſe marks. According to a moſt acute contemporary author, the famous Radcliffe was a complete ſpecimen of the bullying D. "With ſmall ſkill in phyſic, and hardly any learning, he got "into practice by vile arts.—He would neglect a nobleman "that gave exorbitant fees;" and, to heighten the inſult by contraſt, "at the ſame time carefully attend a ſervant or mean "perſon for nothing—he was ſurly and moroſe; treated his "patients like dogs—extended his inſolence even to the royal "family—ſcorned to conſult with his betters on what emer-"gency ſoever; looked down with contempt on the moſt "deſerving of his profeſſion, and never would confer with "any phyſician who would not pay homage to his ſuperior "genius, creep to his humour, and never approach him but "with the ſlaviſh obſequiouſneſs of a court flatterer."

2. The

2. The *bacchanalian Doctor*. D. given to sottishness, if not to drunkenness—generally somewhat of the bully.

3. The *solemn Doctor*. D. with garb, voice, gestures, and equipage, contrived to overawe weak imaginations, and hide the futility of his art *.

4. The *club-hunting Doctor*. D. frequenting the crowded haunts of men; pushing himself forward, saluting all he knows, and all who will know him; talking much and loud †.

5. The *burr Doctor*. D. fastening himself upon you as tenaciously as the heads of the noisome weed *(centaurea calcitrapa)*, from which the trivial name of the sp. is taken, fix upon your clothes ‡.

* D. of this remarkable species first practised physic with pomp: they invented or borrowed from the other professions those barbarous habiliments, of which ridicule has but lately stripped physicians. In times, when an huge wig, or a flowing gown, could more effectually command respect than sound morality, substantial justice, or useful skill, the stratagem succeeded to admiration.

D. of this species, when a pretext offers, speak ostentatiously of their experience—never suspecting any of their hearers may know that there are understandings which multiplicity of appearances serves but to confound.

† In England, D. of this species have of late been frequently seen in paroxysms of frantic loyalty, and of civisme in France.

‡ Nothing in art, but the juggler's address in making you take what card he pleases out of a pack, equals the dexterity with which D. of his sp. force themselves on patients.

6. The

6. The *wheedling Doctor.* D. with an everlasting ſmirk upon his countenance—frequent at the polite end of large cities, and at places of faſhionable reſort.

Var. α. The *Adonis wheedling D.* D. with an handſome face, joined to the wily addreſs, characteriſtic of the ſp.—flouriſhes at watering places; ſometimes joins to his profeſſion the trade of a fortune-hunter; and if he ſucceeds, "gives phyſic to the dogs *."

The Adonis D. has ſooner or later a patient of note, ill of a fever or ſome diſeaſe, that uſually terminates favourably; in caſe of recovery the female buſy-bodies of the place, exert their ſpirit of cabal in behalf of the wonder-working youth, and his fortune is made.

7. The *caſe-coining Doctor.* D. publiſhing forged or falſified caſes †.

8. The

* D. of his ſp. when moſt moderate, preſcribe for every rich patient two draughts a day, and one night draught, beſide pills and powders.

† A very fertile ſource of falſe facts has been opened for ſome time paſt. This is, in ſome young phyſicians, the vanity of being the authors of obſervations which are often too haſtily made, and ſometimes, perhaps, very entirely dreſſed in the cloſet. Cullen. Mater. Med. I. 153.

Akin to this flagitious abuſe is the practice of purchaſing falſe atteſtations, on oath, for advertiſements; and what is ſtill worſe in effect, though not in intention, a cuſtom beginning to prevail among perſons of diſtinction—who cannot

be

8. The *good-ſort-of-man Dr.* D. a good ſort of man, armed, by ſome miſtake, with a diploma.

Var. . The *goſſiping good-ſort-of-man* D. fetches and carries ſcandal *.

9. The *ſectarian Doctor.* D. dwelling among his own people at firſt; and by them often puſhed on to ſpread devaſtation among the reſt of mankind †.

Var. α. The *inſpired ſect. Doctor.* D. believing himſelf to be inſpired with the knowledge of diſeaſes and remedies.

N. B. Teachers of phyſic have been conſidered in civilized countries not much unlike witches. Among rude tribes, as among the Tartar hordes, a kindred variety is univerſally found. See Gmelin's Travels. But theſe ſeem rather to pretend to inſpiration, than really to believe that their deity ſerves them in the capacity of prompter: and they conjoin the characters of prieſt and conjurer with that of phyſician. I have not been able to aſcertain whether our variety receives the afflatus, except in its medical capacity: and the miracles it has

be ſuppoſed capable of diſcriminating diſeaſes, or deciding on the efficacy of drugs—but who, nevertheleſs, permit *quacks* to uſe their names in teſtimony of cures, which they ſuppoſe themſelves to have witneſſed, or experienced.

* Varieties numerous as the hues of the cameleon.

† Varieties manifold; each diſtinguiſhable by the livery of its ſect—one is too curious to be omitted.

wrought

wrought in this, are not ſo perfectly authenticated, as to ſilence cavillers *.

* People are now-a-days delicate in giving recommendations on ſome occaſions; but the beſt bred perſons make no ſcruple of preſſing a favourite phyſician or apothecary upon their acquaintance. Yet one would think that they are nearly as competent to ſpeak to the merit of a footman, as of a preſcriber or compounder of drugs.

Sects ſometimes improve this propenſity into a regular ſyſtem of cabal. The deeper the hypocriſy, or the wilder the enthuſiaſm of the ſect. Doctor, the more eagerly will his brother-fanatics daſh through thick and thin to ſerve him.

Now, as belief or diſbelief in certain points of theology, has no apparent connexion with ſkill in the adminiſtration of antimony, mercury, opium, and bark, we may deduce from this fact a rule which is probably as little liable to exception, as any that be laid down on the whole ſubject.

Never call in a phyſician, becauſe he is recommended by a perſon of the ſame ſect; the more you are urged, be the more on your guard againſt the ſnare. This rule extends to all demoniacs poſſeſſed by the corporation-ſpirit, and to all ſets of perſons remarkably gregarious.

This genus, ſpecies, and their varieties, are taken from Dr. Beddoes' Jatrologia in the life of Dr. Brown, when contemplating the cauſes of the failure of phyſicians of great ability.

Genus II.

THE APOTHECARY *, WHO CONSIDERS HIS EMPLOYMENT AS A CHANDLER'S SHOP, AND HAS ALL THE MEAN JEALOUSIES OF TRADE.

* The word apothecary is derived from αποθηκη, a ſhop, theſe being *originally* mere compounders of medicine. After a time they began like phyſicians to order, but ſtill charged nothing for advice, and had their advantage only in the drug. Uniting both characters, people were ſoon conſtrained to take a vaſt load of unneceſſary drugs, and thus were theſe men paid for their double office. One of the misfortunes to counterbalance the bleſſings of riches, ſays Dr. Beddoes, is that of being unneceſſarily obliged to take more medicine than is proper, and the honourable avocation of medicine has juſtly come into deriſion and diſrepute.—But is there no remedy againſt this enormous evil, which can put the apothecary upon another and more reſpectable footing. Why ſhould he not as well charge his *attendances* as the attorney, for health is certainly of as much value as the preſervation of riches, and then there would be no occaſion to make an *overcharge* for medicine, or to *drench* patients to produce a proper reckoning. If apothecaries muſt keep ſhops, the drugs ſhould be fixed by act of parliament, as much as bread, and charged for accordingly. In the preſent day a pennyworth of rhubarb, or a little tartar emetic mixed with an ounce of pure water, is unbluſhingly charged *one ſhilling and ſixpence!*—A reformation here is anxiouſly to be wiſhed, and we truſt is at no great diſtance. The country apothecaries have already begun to charge their viſits, and why, I would aſk, might not the ſame be accompliſhed by the London apothecary?—People then would not ſo much diſtruſt the means uſed by the apothecary, nor ſuſpect when the phyſician was called in (an opinion I know to be [illegible] well founded), a colluſion betwixt the phyſician and the apothecary to the detriment of the patient.

In a poem publiſhed by one of this tribe, ſpeaking of pneumatic medicine, this rhymiſt laments the injury likely to accrue from it to the phyſician, the apothecary and druggiſt, as it could not come into a gallipot, or be put up into ounce phials *.

THE LAMENTATION.

No more ſhall Warwick-lane e'er boaſt of know-
ledge,
No more phyſicians argue, in their college,
On topics ſuch as *hitherto* they've choſen,
When principles much diff'rent were ſuppoſen.
E'en though they have the ſkill of Dr. Marriot,
But few ſhall henceforth ride in *their own* chariot,
But if they come *old* principles to broach,
Shall gladly do it in a hackney-coach.
Woe! to the druggiſts too, and all who ſell
Med'cines to heal the ſick, and make them well.
In queſt of ſimples, o'er our fields, they'll roam
No more, but ſadly moan their fate at home;
Unleſs by *hunger* driv'n mad, and *care*,
They *wildly* ramble in the open air;
" In tatter'd weeds, with overwhelming brows,"
Their thoughts,—of *children* and their tender *ſpouſe*:
Curſing ten thouſand times,—with bitter rage,
The baſeleſs whims of this *pneumatic* age.
Uſeleſs the [illegible] pots, I ſay, and boxes,
Containing no[illegible]for the cure of p——s!

[illegible] into barrels, and
for accordingly, [illegible] the appendix to this vol

Druggiſts and *herbpoliſts*, no more ſhall know
Thoſe bleſſings which from induſtry do flow,
But, with apothecaries in deſpair,
Shall imprecations pour on *vital air*;
Since vital air, though for ſome uſes good,
Is, when alone, but unſubſtantial food;
And they, who feed on't, will not like their cooks,
As meagre diet cauſes meagre looks.

Oh! ſuch a direful change muſt theſe men feel,
They'll be the pooreſt in the common-weal.
With wretchedneſs and need their eyes ſhall ſtare,
Their ſtomachs empty, and their backs half bare.
To Mantua, no more need Romeo go
To buy his poiſon ſince *at home* we'll ſhow
Apothecar'es, as wretched and as poor
As thoſe poor wretches who once ſought for cure
Within *their* ſhops; when the *long ruffled* ſhirt
Serv'd to ſecure their lily-hands from dirt;
But now, alas, ſo chang'd their ſituation!
That, of all men, they're pooreſt in the nation.

E'en country *curates* not ſo bad as they,
Though thirty pounds a year be all their pay.
(*Laud!* to thoſe biſhops who enjoy, at eaſe,
As many *hundreds*, as, of *pounds*, have *theſe*;
Nor ever ſtrive to meliorate their ſtate,
Till *faction* thunders at the *palace*-gate;
But, with *ſuch* prelates, I'll not ſpend more time,
For, *Eſculapius*' ſons engage my rhyme.)
Such as—*grown old*—have ſpent their youth in riot,
And not provided 'gainſt old age for quiet,
Will ſurely live upon cameleon-diet.

No

No more the *powder'd* wig, gold-headed cane,
Gold ſnuff box, and what elſe made up the train
Of *healing* wiſdom, ſhall to them pertain,
Or, if they ſhould, no more a *ſource of gain* *.

Genus III.

THE APOTHECARY, WHO IS TOO WELL ESTABLISHED TO FEAR BEING INJURED BY ANY INNOVATION: BUT DOES NOT LIKE TO BE PUT OUT OF HIS WAY, AND GO TO SCHOOL (AS HE CALLS IT) AGAIN.

There are ſome men, ſays Dr. Johnſon, of narrow views and grovelling conceptions, who, without the inſtigation of perſonal malice, treat every new attempt as futile and chimerical; and look upon every endeavour to depart from the beaten track, as the raſh effort of a warm imagination, or the glittering ſpeculation of an exalted mind, that may pleaſe and dazzle for a time, but can produce no real or laſting advantage.

Theſe men value themſelves upon a perpetual ſcepticiſm; upon inventing arguments againſt every new undertaking; and when arguments cannot be found, upon treating them with contempt and ridicule. Such have been the moſt formidable enemies of the great benefactors of the world; for their notions and diſcourſe are ſo agreeable to the lazy, the

* Vide the Golden Age, a poem, by Mr. ——, apothecary, ſurgeon, man-midwife, chemiſt and druggiſt, dentiſt and cupper, corn-cutter, &c. and formerly of the Barber's Company.

envious,

envious, and the timorous, that they seldom fail of becoming popular, and directing the opinions of mankind.

Genus IV.

The Quack.

A MONSTROSITY, A FIEND OF NIGHT, WHO HATES AS MUCH THE ALL-PIERCING BEAMS OF SCIENCE AND OF TRUTH AS THE DEVIL, IN MONKISH TIMES, WAS SUPPOSED TO DREAD HOLY WATER.

SECT. XXV.

THE FRIENDS OF PNEUMATIC MEDICINE.

Genus V.

These are indeed friends to every laudable endeavour to improve science, and more especially so important a one as that which concerns health, in which we are all interested, from the king to the peasant; there are the young under the age of forty, some few superior spirits past the age of forty; those who would not have a needless pang in the world, and consider themselves rather as guardian-angels *than as* vultures *upon earth preying upon the mangled and bleeding carcases of their fellow creatures.*

APPENDIX.

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APPENDIX

TO

VOL. I.

Vo[illegible]

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RECAPITULATION

OF

WHAT HAS ALREADY BEEN DONE

BY THE

OXYGEN, AND AZOTIC, AIRS.

I. HYDROCEPHALUS, OR DROPSY OF THE BRAIN.

HYDROCEPHALUS.	CIRCUMSTANCES.
Case I. Lydia Johnson, under Dr. Thornton, cured. Vide No. XVIII. of the Philosophical Magazine, page 196.	Blindness complete, pupils greatly dilated, which originated from a putrid fever violently affecting the brain; had fits very frequent. By encreasing the quantity of vital air to 12 quarts, sight was suddenly restored whilst inhaling.
Case II. Thomas Mead, under Dr. Thornton. Remarkable alteration. Vide Part III. of Dr. Beddoes' Considerations, page 11.	Six weeks in St. Thomas's Hospital, dismissed as incurable by Dr. Fordyce. Messrs. Wathen and Phipps, oculists, thought the case incurable. Pupils dilated, pulse sluggish, subject to fits. In three days after inhaling the vital air, began to distinguish objects. Sight improved daily; his fits left him. He then left off taking the vital air.

II. AMAUROSIS, OR GUTTA SERENA.

Case III. Hon. Miss W —, under Dr. Thornton, relieved. Vide Part III. of Dr. Beddoes' Considerations, page 78.	Under the care of Messrs. Wathen and Phipps. Could not tell the hour from the Horse-Guards clock; after six weeks enabled to distinguish the hour very [illegible]dily.
Case IV. Mrs. Benham, under Dr. Thornton.	In ten days after inhaling the vital air, could read a small print, which she could not do before.

III. DEAFNESS FROM AN ULCER IN THE EAR.

DEAFNESS.	CIRCUMSTANCES.
Case V. A boy, under Dr. Thornton and Mr. Hill, relieved. Vide Part II. of Dr. Beddoes' Considerations.	So deaf as not to hear the tower guns: could hear after a short time even a rap at the door, or any other loud noise.

IV. OPHTHALMIA, OR CHRONIC INFLAMMATION OF THE EYES.

Case VI. Miss Goudy, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XII. page 418.

Communicated by Dr. Thornton.

Miss Goudy, æt. 11, living No. 171, High-street, Shadwell, had been subject to occasional attacks of this disease for eight years past. In one attack, some years ago, a skin formed over the right eye, which was removed by a caustic powder blown into it by order of Mr. Sharp, and sight was restored in about a month: this eye has, however, since been subject to become inflamed upon the least cold, when the face enlarges prodigiously, looks red as fire, with intense burning. She had taken a great quantity of medicine under Messrs. Young, Ward, Evans, &c. without any marked advantage, previous to her parents making application to me. When I saw her, her right eye was much inflamed, and the upper lips and cheeks were tumefied in a frightful degree. It was a new case, that required much consideration. Were the vessels in a state of inflammation from tone, or from debility? Examining the arms I found them remarkably blue and mottled, the feet were always uncommonly cold, the appetite craving, or else none, much flatulent, great distention of the abdomen at times, and a tendence to chlorosis. The pulse small, and quick. I accordingly ordered the super-oxygenated air, November 27, 1798, gradually augmenting its power. Memorandum—December 4, feels always a great glow over the whole body, after inhaling the vital air. Inflammation of the eye gone. I ordered a seton in the neck, to hinder a relapse, by its inviting the blood to a neighbouring part, and setting up a new action: and without fear I now pursued the tonic and stimulant plan, viz. bark, myrrh, and steel, and a super-oxygenated air*; and my fair patient was soon perfectly cured, and continues so, I am happy to say, to this day.

* The proportion was generally six quarts vital air mixed with twenty of atmospheric.

V. HEADACH.

HEADACH.	CIRCUMSTANCES.
Case VII. Mrs. S —, under Dr. Darwin, cured. Vide Part II. of Dr. Beddoes' Considerations, page 63.	A pertinaceous headach, and so far reduced as not to be able to rise from her bed. She always, says Dr. *Darwin*, found herself revived by the inhalation, and gradually recovered her health, and became stronger than she had been for some years, and freer from the pains in her head.
Case VIII. Mr. Monier, under Dr. Thornton. Vide Part IV. of Dr. Beddoes' Considerations, page 134.	The headach was accompanied with stupor, and frequent giddiness, and had continued unremittingly for six weeks.

VI. MANIA, OR MADNESS.

Case IX. Mr. Windy, under Dr. Thornton, cured. Vide Part III. of Dr. Beddoes' Considerations, page 109, and the Rev. Mr. Townsend's Elements of Therapeuticks, Vol. I. page 2.	*Communicated by the Rev. Mr. Townsend.* He was gloomy, sullen, and silent, or muttered only expressions which evinced the terrors of his disturbed imagination. He had no recollection of his wife or children, and the only notice he took of his attendants, was to manifest suspicion that they meant to injure him. He made several attempts to destroy himself. In ten days from the time of his inhaling the vital air, he became conscious of the presence of his wife and children, whom he called by their proper names; walked out and returned home; and before the month was concluded, recollected the money he was possessed of, sent for the guardians of his family, entered minutely into the state of his affairs, and manifested other tokens of sound intellect.

VII. EPILEPSIA, OR EPILEPSY.

EPILEPSY.	CIRCUMSTANCES.
Case X. M—, under Dr. Beddoes. Disease aggravated. Vide Dr. Beddoes' Considerations, Part IV. page 13.	*Communicated by Dr. Beddoes.* About three years ago, a Gentleman, aged 20, took an excursion on the mountains of Switzerland. In the night he dreamed of falling from a precipice, and was seized, as appeared from severe bruises on his hands, with a strong convulsion fit. Valerian and other medicines, called nervous, were administered. Sea-bathing disagreed with him; and after cold-bathing in fresh water, his fits suddenly increased from one or two in a week, to 28 in 24 hours. On discontinuing the cold bath, they diminished in frequency, and have not, for a long time, exceeded 12 in the day and night.

The patient at first inspired a mixture of three parts of atmospheric with one of oxygen, for ten minutes at going to bed. As I then used Mendip manganese, the quantity of oxygen must be considered as less than the numbers would otherwise imply, because that manganese yields much azotic gas at the end of the process, and because the carbonic acid, which the calcareous spar it contains, was not probably all washed away. No effect being observable, next night (Saturday night) he was desired to respire for 20 minutes; afterwards he felt an agreeable glow in his chest. On Monday night, at three intervals, he respired for half an hour. I ordered him now a saline draught with 20 drops of antimonial wine; and I requested that he would drink three glasses of wine instead of four, which was his usual quantity. On Tuesday night he respired for 20 minutes. On Wednesday the air was omitted by way of precaution. On Thursday, as no suspicious effect appeared, and as he passed good nights, and for two of these days had no fits, he was ordered a mixture of oxygen one part, atmospheric air two parts; and of this he respired for half an hour, and felt uncomfortably hot afterwards. In the morning his pulse was 72, and of natural strength. He coughed slightly, but found himself very well. He had no fit all Friday. A relation who had watched him with great tenderness ever since the commencement of his indisposition, thought him *better*, and wrote a favourable account to his distant friends.

Towards night the patient was unusually lively, but quite composed. The respiration of factitious gas was omitted, as I had originally determined to wait the event as soon as any distinct change should have taken place. He had scarce lain down in bed when he was alarmed with startings of the abdominal muscles, as I imagined from his description. This had ceased

before my arrival, but I found him flushed and with a pulse rather strong, and above 100. He had a constant propensity to motion, but was easily persuaded to exert himself to keep still. As he was never left alone, I was quite certain that he had taken no stimulant. His wine had been dropped this day. He appeared however as if at once a little intoxicated and alarmed. A slight fit now intervened, and increased his apprehensions. In the night he had a frantic attack, accompanied with singular agitations of the muscles, which was a new circumstance. His lower extremities were frequently in action, and his toes would move, like the fingers of a person playing on the harpsichord. But his most constant movement was that of his arms; and it was very curious, exactly imitating the gestures of a person driving a phaeton; to which the patient had been long accustomed every morning, but had discontinued it for a few days. These gestures continued frequent till Monday. He declared that he could not restrain them; and at breakfast on Monday, when he was quite sedate, seemed rather amused with his own inability in this respect. For the first 24 hours he had only five or six slighter fits; but then he had no rest till Saturday night; when he fell into a profound sleep, and had the usual number of fits of both kinds, with a paroxysm early on Sunday morning. On Monday, before day-break, he had a similar, but fainter paroxysm, which was the last. During the rest of Sunday night he slept very profoundly, as he had also done in the day-time. At this period the muscular agitations were principally confined to the fingers. He was left stiff and sore, as from severe exercise: the air was not resumed, and *the patient soon became what he was before respiring the super-oxygenated air.*

EPILEPSY	CIRCUMSTANCES
Case XI. Miss N—, under Dr. Thornton. Disease aggravated. Vide Dr. Beddoes' Considerations, Part IV. page 18.	Miss N. had been long subject to epileptic fits. She had not however had an attack for six months. Upon inhaling the vital air on account of the loss of health, she was immediately after the trial seized with an attack. For some minutes this amiable lady remained torpid; then she violently struggled with convulsive motions of the

legs, and sometimes of the arms, overcoming the strength of her attendants. She at last grew delirious; pointed to a particular spot in the room; roamed in her imagination; her eyes were fixed and glared; she now attempted to bite her attendants; and after passing three hours in this dreadful state, she fetched a deep sigh, and gradually recovered, unconscious

of what had happened. She was, however, unable to stand, felt a violent head-ach, and went to bed. The next day, as was usual, she had lost her voice. In consequence of this attack, says Dr. Thornton, the vital air was desisted from for a week, during which time she had no return; but upon another trial of the vital air, the same dreadful scene was immediately renewed, and the vital air after that was discontinued, and the fits did not again recur.

Observations on this Case by Dr. Thornton.

Reasoning now on this case, I conjectured that, as the *aorta descendens* passes between the slips of the diaphragm, and this muscle partakes of the same nerve as the stomach, it seemed probable, that when this viscus was loaded with mucus, a spasm or spasms of the diaphragm might succeed, compressing betwixt its two crura the aorta: hence the difference of the appearance and feeling of the upper from the lower parts of the body. The loss of voice, the globus hystericus, and the rabies, which frequently attend these fits, seem also to prove the same sympathy; as the recurrent nerve, which supplies the throat, is a branch also of the *par vagum*; hence also when the blood was determined to the head the recurrences of the fits.

EPILEPSY.	CIRCUMSTANCES.
Case XII. Mrs. Paynter, under Dr. Thornton. A cure produced. Vide Dr. Beddoes' Considerations, Part V. page 20.	*Letter from Dr. Thornton to Dr. Beddoes.*

SIR,

After the above-mentioned unsuccessful trials, Mrs. Paynter, who lives at No. 2, Brompton-terrace, came to consult me. She had been subject to hysterics, faintings, and epileptic fits, for more than seven years. She had no appetite, weak digestion, excessive debility, coldness of the lower extremities, flatulence, emaciation, disturbed dreams, palpitations of the heart, and great lowness of spirits. Having premised an emetic and cathartic, and cleared away the superabundant mucus of the primæ viæ, I then gave the vital air; and the accelerated blood meeting with no obstruction in the aorta, diffused heat through the whole system. To prevent the glands, or exhalant arteries, of these parts, from throwing out too much mucus, I next gave tonics, as bark, myrrh, and steel; and, by using occasional evacuations, continuing the daily inhalation of the vital air, after ten days the fits no longer made their appearance, and her appetite, complexion, and sleep returned; and at the end of six weeks her constitution was so firmly established, as to need no more medicine or air.

I am, &c.

R. J. THORNTON.

VIII. SCROPHULA, OR KING's-EVIL.

SCROPHULA.	CIRCUMSTANCES.
Case XIII. Miss Holmer under Dr. Thornton, cured. Vide Number IX. of the Philosophical Magazine, page 90.	*Communicated by Dr. Thornton.*

Miss Holmer, æt. 18, an amiable and accomplished young lady, the daughter of a wholesale ironmonger in the Borough*, so early as at the age of seven had the glands of the neck beginning to take on disease. First one gland under the ear then another, and by degrees all the glands about the neck became enlarged, and went on gradually increasing. The same disposition also shewed itself by an affection of the eyes, for which this lady was nine months under the care of Mr. Ware. During the progress of glandular affection, she was under Messrs. Kent, Fearon, Bayley, &c. &c. and Dr. Saunders. Mercury was used externally and internally, until the teeth became loosened; bark, and steel, and soda, or fossil alkali, given in profusion; but each practitioner in turn relinquished the case, recommending sea air, which was had recourse to at sundry times. This young lady was latterly referred to John Hunter, who employed hemlock to an uncommon extent; and he also, as the sea air had been before tried without advantage, advised the parents to do nothing further, saying, with his usual bluntness, that it was a case of that nature that whoever would undertake the cure would do it only with the intent of picking their pockets. When I first saw the young lady, I observed the glands of the throat, even from the nape of the neck, so enlarged as to defeat all concealment, and forming one apparently homogeneous mass, extended even over the jaw-bones, which could not be felt, and suffocation was threatened by pressure on the wind-pipe. Her relations ridiculed the idea of any farther application for this disease: but parental fondness urged an enquiry relative to the airs. The Rev. Mr. Townsend, rector of Pewsey, author of a very excellent work on physic, the Guide to Health, happened to be at my house when the lady arrived. Although he conceived highly of pneumatic medicine, as may be seen throughout his work, he told me, "that he must consider me as "very bold if I could venture to undertake such a case, which "he acknowledged to exceed any thing he had ever before "seen;" and Mr. Jones, an eminent apothecary in Mount-street, declared, that if I produced a cure here, all he could say was "that miracles had not ceased." I, however, was not dis-

* This lady had all the benefit of country air, her father having a house at Vauxhall, and keeping his carriage.

couraged, and the event has proved that we should not, having such new and powerful agents as the airs, readily give way to despair. In a month after commencing the inhalation of vital air (six quarts daily mixed with thirty of atmospheric), the knot of glands began to soften, yielding a little to external pressure: by degrees they separated from each other, and thirteen glands could be directly made out: the jaw-bones became liberated; and these, whether from pressure of the glands, or imperfect ossification, were bent up a little from their natural course; and, not to tire the reader, I shall finally remark, that in less than eight months the decrease was five inches by measurement round the neck! The hands, which before were unusually cold, were comfortably warm during the whole time the vital air was inhaled, and the appetite and spirits increased. Mr. Cruickshank observed, that during the time of inhaling the superoxygenated air, the pulse was raised about six beats in a minute, and became stronger. I must beg leave to mention here, that I also roused the absorbents by both topical as well as internal remedies. But why I place such a stress on the power of the vital air over this system of vessels, is, that from the experiment of Dr. Beddoes, which he made upon himself, while inhaling a superoxygenated air, he became, he observes, considerably diminished in bulk, although he eat twice as much before, which I conceive could only arise from the superior energy given to the absorbents by the vital air.

SCROPHULA.	CIRCUMSTANCES.
Case XIV. Mary Buchanan, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 144.	*Letter from Dr. Thornton to Dr. Beddoes.* Mary Buchanan, aged 8, lives at No. 2, Whitcomb-court, Hay-market; from the account of her mother she was weakly from her infancy. She was two years and a half before she walked; her limbs were crooked, understanding remarkably acute, under lip prominent, eyes black, hair lank; was trou-

bled with worms, both the teretes and ascarides; for which she took Evans's powder, which brought away much slime, and many worms: but, from these powerful evacuations, she was much debilitated, and became subject to profuse perspirations, and for a long while was constantly ailing; when, whether from cold, or what other cause, or the nature of scrophula, I cannot determine, she was seized with deafness; and afterwards with such an inflammation of her eyes, that she was blind for above ten days: leeches were applied to the temples with some effect; but these symptoms only seemed to retire, to give way to a more formidable symptom, namely, an enlargement of a gland of the

neck on the left side, which, for three months, kept on encreasing both in size and hardness; and the child continually leaning on that side, the head became immovably sunk; so that the ear, night and day, nearly rested on the left shoulder. The countenance of the child was pale, body costive, belly large and hard, breath offensive, particularly so towards morning, feet cold, itching of the nose, appetite often keen, but there was no starting in her sleep, grinding of teeth, or any worms observed in her evacuation, although much mucus. She was placed, and continued under the care of my friend Mr. Hill, a week. He gave her rhubarb and vitriolated kali night and morning. Sorrel poultices were applied to the neck, the vital air was inhaled, and the case was going on very well, when Mr. Hill had occasion to leave town, and it then entirely rested upon me. I followed Mr. Hill's practice, and in addition employed electricity on the tumour, and directed a tonic mixture of bark and steel, keeping the body gently open with the powders. The tumour was at this time the size of a goose's egg, and very hard. Since the application of the sorrel, it was looking somewhat red. In a week there was produced a considerable softening, accompanied with violent pains and restless nights. I ordered an opiate in the evening. In a few days after this, I made a scratch, on the most depending part, with a lancet, and repeating this three successive days, on the fourth there issued through this small orifice a bloody serum. I now directed a bread and milk poultice, discontinued the opiate, and increased the proportion of steel. For several days the bloody serous discharge continued, when I ordered the sorrel poultice to be resumed. Almost instantly the purple tumour was rendered florid, the lips of the orifice became of a bright red, violent pain was excited, and, on the next day, matter of some consistency was formed. I moderated the action, when too strong, by a bread poultice; and I sometimes interposed the rhubarb aperient; and, by always keeping up a due action, in a month the tumour was wholly removed; the child can now turn her head in all directions; she has the appearance and manners of health; and, instead of being disfigured, there remains now a scar not larger than a pea, and not discernible but upon the closest inspection.

SCROPHULA.	CIRCUMSTANCES
Case XV. Mr. Cooper, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 71.	*Letter from Mr. Cooper to Dr. Beddoes.* Dacre-street, Westminster, July 29, 1795. SIR, I was above nine months afflicted with hard tumours, which were very slow to suppurate, and when they did, produced only a watery discharge, and a sore, that

took a long time in healing. These appeared chiefly about the throat. Previous to this, I had frequent eruptions on my face, for which I was often purged and bled, which in my opinion might have produced the disorder I am attempting to describe to you. It soon became necessary to try every means to get rid of it, and I took a vast quantity of different medicines; but the tumours continued rather to increase in size and number, and produced a continual inconvenience to me. As the vital air is said to alter the character of the blood, and I conceived my case arose from a broken state of blood, I waited on Dr. Thornton, who thinking these tumours very likely to be removed by the air, wished me to make the trial. At that time several of the tumours were commencing, others were upon the point of breaking, and others again were in a state of open sore. My bowels were first cleared, and I inhaled the vital air, and took bark twice a day in powder. The effect the air had on me was, as my mother and sister observed, to make me eat more than usual. I felt uncommon spirits, and no longer complained of chilliness. The tumours that were in their first state, disappeared; the others looked redder and gave me more pain, and discharged matter. But in a fortnight these also yielded to the air and disappeared, and I was cured. But what surprised me most was the change it produced in my eye-sight. My eyes for the space of fifteen years had been uncommonly weak; so weak, that I was never able to read or write by candle-light, but from inhaling the vital air, they have acquired such strength, that latterly I have sat up writing in my books, sometimes from twelve to one o'clock, without feeling my sight the least fatigued. My mother used to attribute my weakness of sight to my having had the measles very bad. I am at the present time perfectly well, and without any fear of my former afflicting disorder.

I am, Sir,

With the greatest respect, &c.

HENRY FREDERICK COOPER.

SCROPHULA.	CIRCUMSTANCES.
Case XVI. Mr. —, under Mr. Barr, cured. Vide Dr. Beddoes' Considerations, Part I. page 60.	*Letter from Mr. Barr to Dr. Beddoes.*

Birmingham, 14th March, 1795.

DEAR SIR,

Having a very high opinion of the effects to be expected from the practice which you have so benevolently promoted; and wishing to encourage farther experiments upon a subject so interesting to humanity, I take the liberty to communicate to you some observations which I have made on the effects of different factitious airs in the cure of scrophula.

About four months ago, a gentleman of this neighbourhood applied to me for advice in the management of a scrophulous ulcer of considerable extent. He had tried various remedies, but had derived no lasting advantage from any of them. When I first visited him he was worn down by a long course of night watching. The deep-seated pain of the arm was so constant and severe, that it had in a great measure deprived him of sleep. His countenance was pale and sickly; his limbs were continually afflicted with aching pains; every exertion, even the most gentle, seemed beyond the measure of his strength, for his body had lost much of its active power, and his mind much of its wonted energy. The discharge from the ulcer was copious, thin, bloody, and corrosive; and besides, the whole surface of the sore was so exceedingly irritable, that the mildest dressings, applied in the gentlest manner, produced very severe and lasting pain. During the first six weeks of my attendance, he regularly took as much Peruvian bark in substance as his stomach and bowels could bear; and the ulcer was dressed with various emollients, sedative, and astringent applications, but without any permanent advantage. I then recommended a trial of oxygen air, which was readily complied with. He began by inspiring four ale quarts diluted with sixteen of atmospheric air twice a day, and gradually increased the quantity of oxygen to a cubic foot and a half in the day; by pursuing this plan for about a month, his health was wonderfully improved, but the ulcer shewed no disposition to heal. The deep seated pain was now entirely removed, but in the space of a few days more, he complained of a burning sensation over the whole surface of the sore, similar to the pain arising from erisypelatous inflammation. This unpleasant sensation first commenced after inspiring the whole quantity of oxygen in the space of two hours, which before had been taken in equally divided portions morning and evening. We still pursued our plan, thinking that this new pain might be owing to some accidental circumstance, and that it would soon pass away. But it every day continued to increase, and the ulcer began to spread wider and wider. The edges became thick, and were turned outwards, and the discharge became more thin and acrid.

In this situation, a local application seemed proper. I wished to have applied hydrocarbonate externally to the ulcer, but this, from some circumstances of the case, was not practicable. I then thought to moderate the stimulus of the oxygen by a mixture of hydrocarbonate, which Mr. Watt told me would occasion no chemical change in the two airs. Accordingly a mixture of three parts of oxygen, and one of hydrocarbonate was prescribed. Four quarts of this mixed air were added to about sixteen of atmospheric, and this quantity inspired morning and evening. In less than a week the burning sensation was much diminished, and the ulcer put on a more healing appearance.

The mixed air was then increased to five quarts, and used as before, which produced an increase of all the good symptoms. After a few days trial of this proportion of the mixed air, six quarts were prescribed. This is the quantity now inspired morning and evening.

My friend, at present, enjoys good health and a good appetite, and feels himself as strong as at any former period of his life. The ulcer is now reduced to less than half its original size, and healing rapidly. There is neither superficial nor deep-seated pain remaining, and the motion of the joint, and the action of the contiguous muscles are free and easy.

I am, dear Sir, &c. &c.

JOHN BARR.

SCROPHULA	CIRCUMSTANCES
Case XVII. Mr. —, under Mr. Barr, cured. Vide Dr. Beddoes' Considerations, Part IV. p. 155.	*Letter from Mr. Barr to Dr. Beddoes.*

Birmingham, Aug. 20, 1796.

DEAR SIR,

I transmit to you the following ideas on the effects of factitious airs in cases of surgery, to induce the humane practitioners of that art to extend the application of them. In the management of large ulcers, when the discharge is thin and copious, the great desideratum is to increase the absorption: for, unless secretion and absorption maintain a just equilibrium, a cicatrix can never be formed. But the most skilful surgeons frequently know not how to accomplish this end. The whole list of general and topical remedies at present known, however judiciously applied, are always slow in their operation, and sometimes entirely fail in producing the desired effect.

A patient of mine, afflicted with scrophulous swellings and ulcerations, who had for some time inhaled oxygen air, and had been much improved in his state of health by the medicine, desired me one day to examine his head, as he feared some fresh ulcers were about to break out there. Upon examination, I found the skin raised in several places, by collections of effused lymph; each tumour containing apparently from half an ounce to an ounce of fluid. In this manner, he informed me, the complaint usually began; the lymph gradually accumulating till it produced inflammation of the skin, and an ulcer, extremely difficult to heal. The process followed exactly the same course when he inhaled oxygen. A mixture of oxygen and hydro-carbonate was then tried: the fluid was soon completely absorbed, and the tone of the relaxed skin perfectly restored. The experiment has been repeated five or six times on the same and other patients, and has uniformly produced the same effect.

I am, respectfully, your's,

JOHN BARR.

IX. HYDROTHORAX, OR DROPSY OF THE CHEST.

HYDROTHORAX	CIRCUMSTANCES.
Case XVIII. Sir William Chambers, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. p. 3.	Having been informed, says Dr. Beddoes, that Sir William Chambers, when labouring under the pressure of unspeakable distress, had derived more than present relief from oxygen air, I requested from him an account of the effects he had experienced from it, and received the following letter:

Letter from Sir William Chambers, Knight of the Polar Star, F. A. S. &c. &c to Dr. Beddoes.

Upper Norton-street, June 20, 1795.

SIR,

As every person of a benevolent mind and enlarged understanding must approve of the design of those gentlemen who are endeavouring, from a philosophic induction, to introduce aerial remedies for the removal of otherwise incurable diseases; and as my case appears such as to demonstrate the efficacy of the vital air in a disorder that has hitherto resisted the ablest practitioners in physic, I will attempt, as far as lies in my power, to describe my situation, and the effects which I experienced from this new remedy, and shall be truly happy should the same advantages be felt by others under similar circumstances.

Previous to my coming under Dr. Thornton's care, every means which extensive experience and great abilities could suggest, had been tried by my friend Dr. Turton. My complaint seemed to be of such a nature as to baffle all the powers of art. I was at that time hardly able to move from one chair to another. It was with the utmost difficulty I could get up stairs. I had water in both my lower extremities, and great oppression on my breath, so that when I lay down to sleep, I was frequently obliged to start up and resume an upright posture, to prevent myself from being, as it were, suffocated. My nights were bad, my appetite gone, and for months I had not been able to swallow any thing solid. Indeed I had given myself up as a lost man, until I heard of the vital air, which my friends told me had done such extraordinary things in medicine and surgery. I conceived that as the application was to the seat of the disease, it promised more than most other remedies, and accordingly, about ten months back, I began the inhalation of this air. Dr. Thornton approved of the plan of medicine I was pursuing, which was bitters to strengthen the system, and as occasion might require, a warm laxative pill; these

were therefore continued. After a few weeks trial of this new mode of treatment by the vital air, the above medicines being continued, my strength was so far recruited, that from my own reckoning, I could walk upwards of two miles; my ancles did not pit; my breathing was relieved; my appetite improved; and my countenance so much mended, that all my friends, together with my physician, congratulated me on my recovery. I was able to pay my respects to his Majesty, who complimented me much on my good looks, and made many inquiries respecting the vital air. I was enabled regularly to attend the Board of Works and the Royal Academy. But I had to battle through such a winter as few, at my time of life, have been able to support. The influenza, which was general, was a great drawback to my full restoration, as the vital air was obliged to be desisted from at that time, and recourse was had to evacuants, cooling medicines, blisters, cupping, and a low diet. But this, together with several colds that have occasionally attacked me, has, in my mind, only manifested the more the efficacy of the vital air in my complaint; for as soon as it has been judged prudent to have again recourse to the vital air, the symptoms that had gained ground during the intermission, have been as constantly subdued, and my friend Dr. Turton has told me, "that I could not do better than to go back to the vital air," to which I do not hesitate to ascribe my present freedom from oppressive respiration; comfortable nights; clean ancles; power of eating solids with appetite; and, in a few words, as much return of health, as a person at my time of life, 75, has reason to expect after such an attack, and I think abundantly sufficient to be thankful for, and to prove the virtue of the vital air, in all complaints of this nature; but this I must leave to you, Dr. Thornton, and others to determine, to whom I sincerely wish every success in your laudable attempts to lessen the afflictions of mankind, and have the honour to be,

Dear Sir,

Your obedient humble servant,

WILLIAM CHAMBERS.

HYDROTHORAX. CIRCUMSTANCES.

Case XIX.
Mr. Barbor, under Mr. Barr, cured.
Vide Dr. Beddoes' Considerations, Part III. page 13.

Letter from Mr. Barr to Dr. Beddoes.

Birmingham, Oct. 9, 1795.

DEAR SIR,

I announce to you with much pleas[ure] the cure of a case of hydrothorax, w[hich] had existed for a considerable time notwithstanding the application [of every] known and approved remedy, had reduced the subj[ect] nearly to the last stage of human su[ffering]

Mr. Barbor, of Barton under-Needwood, being in this town on a visit to a friend in the spring of 1793, was seized with an highly inflammatory fever, attended with a violent pain of the side. This fever was followed by a dry tickling cough, [illegible] tightness in breathing, much languor, and a great [illegible] and anxiety. His bowels [illegible] full, tense, [illegible] and he complained that his [illegible] quantity, did not flow freely, [illegible] the sensation of not having evacuated [illegible], boluses of triturated mercury, and a decoction of Peruvian, and afterwards of Angustura, bark [illegible] prescribed. He was relieved by these medicines, but he [illegible] recovered his strength nor his spirits. In this situation nearly he passed the remainder of the year in the country; in the spring of 1794, he came to Birmingham again, with all the symptoms of his disorder increased, particularly the oppression in breathing. He could neither lie down in bed with comfort, nor ascend the smallest acclivity without the greatest uneasiness. His urine was diminished in quantity, and voided with difficulty. A decoction of senek[illegible] root, and small doses of digitalis, were directed and continued for two or three weeks; but they rather seemed to amuse than relieve him. He called on me again last April, and told me that all medicines had lost the power of relieving him; that his breathing was now more generally difficult, that his urine was very scanty, and that his appetite was entirely gone. I prescribed the digitalis with a bitter infusion. He went into the country, and continued these medicines for some time. Towards the end of July he called upon me again; but, alas! how changed! His face was now become pale and emaciated, his eyes stared as if taking a last conscious view of their object; which last circumstance much alarmed his friends. His legs were swelled to such a degree that the skin was become much inflamed, and in danger of bursting; he made very little urine; he could not endure an horizontal posture for a moment, but was under the necessity of being bolstered upright in bed through the night; even then he slept little, and [illegible] little was disturbed and unrefreshing, for he frequently [illegible] from his sleep, under an impression of instant suffocation.

Having seen an account of the happy relief Sir William Chambers had experienced from oxygen in a similar situation, I wrote to my patient, and advised the adoption of the pneumatic plan. [illegible] did this, I confess, in the present instance, with little hope [illegible] advantage; but as the most powerful medicines had pro[illegible] no salutary effect, I felt it my duty to him, as well as to [illegible] cause of humanity, to urge his compliance. I procured him [illegible] ing of the case, and the similarity of the circumstances [illegible] striking, that he agreed to place himself immediately [illegible] my care.

He arrived here on the 12th of August, and began to inspire the factitious air on 15th. I directed one quart of oxygen, mixed with nineteen of atmospheric air, to be inhaled every day; but as the symptoms were become extremely urgent, I thought it right to join the use of those active medicines that I had prescribed for him before. Accordingly I directed him to take half a grain of digitalis in substance, every evening, and four ounces of a decoction of Augustura bark in the course of each day. On the third night after inspiring, he found himself more composed, he could remain longer in one posture, and the startings during sleep, seemed both less frequent and less violent. Every night he was sensible of amendment; in ten days he could bear the removal of several of the pillows that bolstered him up in bed; and he could sleep for three or four hours without one starting fit. The swellings of his legs too began now to subside; the tenesmus was entirely removed; the quantity of urine was much increased, and he could walk up stairs with much ease; his appetite and cheerfulness began to return, and the pale face of disease to give place to the florid countenance of health. In the course of the second week I had gradually increased the quantity of oxygen to two quarts a day, dilated as before. In four weeks from his beginning to inspire the vital air, not a vestige of the disorder remained, except *weakness*; he could lay his head as low in bed as when in perfect health, and sleep the whole night; no swelling of the legs remained; no difficulty of breathing upon ordinary exertion; and every function was performed with regularity and ease. He then went home provided with a pneumatic apparatus, and directions how to use it, and laid aside the use of all medicines, except a laxative pill occasionally. He passed through this town yesterday in perfect health. His strength, agility, and vivacity, are greater than in most men at his age (60).

This case, in my opinion, will add much to the credit of the pneumatic remedy; for though I employed medicines along with the oxygen, yet let it be remembered, that the same medicines had been repeatedly taken without advantage, and before the disorder had made such an alarming progress; add to this, that, during the intermediate periods of the little history which I have given, Mr. Barbor had consulted some of the ablest and most experienced Physicians of the present age, and faithfully followed their directions without any material benefit. May we not therefore conclude that the art of medicine had exhausted all its resources without effect, and that this gentleman had remained a devoted victim, had not this *new* friend to mankind stretched forth her benevolent hand and snatched him from misery and death? This is the opinion of the worthy gentleman himself, of his family, and friends who have witnessed the whole proceedings, and have desired

me to make it thus publicly known, that those in similar circumstances of distress may be encouraged now to hope for a return of ease and health.

I am, dear Sir,

Your's, very respectfully,

JOHN BARR.

HYDROTHORAX.	CIRCUMSTANCES.
Case XX. Mr. W—, under Dr. Darwin, not cured. Vide Dr. Beddoes' Considerations, Part III. page 27.	The patient was aged 60, the hydrothorax had been increasing two years, he inhaled the superoxygenated air a week. It was then left off for a fortnight, and then resumed and taken for a fortnight again, pure, and then left off; after which, for a few weeks, other medicines were employed, and the patient died.

Dr. Darwin observes, when relating this case, that it is probable, that the quantity of oxygen gas would have had greater effect, if it had been respired in a more diluted state. It was also unassisted by medicine.

Case XXI. Mr. G—, under Dr. Beddoes, relieved. Vide Dr. Beddoes' Considerations, Part I. page 164.	This patient æt. 60, after living very freely, had dropsical symptoms. He underwent a long course of violent cathartics, and afterwards came to Bristol Hotwells. The paralytic appearances were so striking, that I declared to his friends, in the most positive terms, that I apprehended he would in no

long time die suddenly. The digitalis (which I have seldom seen to fail in cases of this kind) procured a discharge of the water. It repeatedly collected, and was as repeatedly evacuated by the digitalis, and once or twice by squills and the pulvis ari comp. The medicines had now no sooner ceased to operate, than a relapse followed, and threatenings of apoplexy were several times observed. At this period oxygen air, mixed with twice its bulk of atmospheric, was administered for the space of one minute, four times a day. During the whole course of his disease, the patient had that tendency to sickness and vomiting, which the long abuse of fermented liquors produces. The modified air was found by the patient to relieve these symptoms; and respiring it, he said he could prevent and remove nausea. From his observations I think oxygen air more likely than any thing else to carry off violent affection of the stomach, arising from an over-dose of digitalis. The difficulty of breathing was always relieved by his mixed air, though only for a short time.

In less than a month, he by degrees came to respire for 1[illegible] minutes in a day. The swellings, however, increased, and there were evident signs of effusion in the thorax; so that the oxygen did not appear, in this instance, to render the absorbents more irritable.

X. ASTHMA.

CIRCUMSTANCES.

Case XXII. James Hare, Esq. M. P. under Dr. Beddoes, cured. Vide Dr. Beddoes' Considerations, Part IV. page 49.

Letter from James Hare, Esq. M. P. to Dr. Beddoes.

SIR,

I very willingly consent to your publishing my case, in hopes that other persons may obtain relief from similar treatment. For near *eleven* years I have been subject to frequent attacks of nervous asthma, under which I suffered inexpressibly. Blisters on the chest, with expectorant medicines, usually relieved me, though not till after many hours of agony. I was troubled with this disorder more in damp than in frosty weather. If I caught cold, I scarcely ever escaped it. My strength and spirits were very much affected for a long time after the difficulty of breathing had left me. About the middle of September last (1795) I began to take oxygen air, by the advice and under the direction of Dr. Beddoes. In a few weeks there was a sensible and visible improvement in my general health. Towards the end of October I caught cold, and had a pretty severe fit of asthma, though much less so than many former ones. From that time to the present, I have only had five attacks, all slight in degree and short in duration. For many years past I have suffered much from illness in the spring; but this spring I have not been confined for one hour; and, during the whole ten months I have enjoyed a much better state of health than for many preceding years. Hot rooms and damp weather affect me much less than formerly; and I have caught cold several times without its bringing on an asthmatic fit. Having taken the oxy[illegible]n air once a day (with few interruptions) for about nine mon[illegible] the beginning of this month I discontinued it; in hopes that I [illegible] through the summer without its aid, and so reserve it for exigencies.

J. HARE.

Conduit-street, July 29, 1796.

ASTHMA	CIRCUMSTANCES.
CASE XXIII. Miss Green, under Dr. Beddoes, cured. Vide Dr. Beddoes' Considerations, Part IV. page 59.	Dr. Beddoes, in his Considerations, says he has before him two letters from Francis Green, Esq. of Denmark Hill, Camberwell, respecting one of his daughters, aged 18, who had been for several years violently afflicted with spasmodic asthma. The letters are dictated by that warmth of kindness,

which an affectionate parent feels towards those whom he considers as having been instrumental in rescuing his child from an obstinate and most violent disorder. The following are the facts stated by Mr. Green. The paroxysms, before the patient's arrival at Bristol Hotwells, in October, 1795, had "come on "periodically once a week. There she grew much worse, "until some short time after I had the pleasure of meeting with "you. I must acknowledge I think the vital air has been wonder-"fully serviceable to her." This letter is dated September 14, 1796. The essential part of the 2d letter runs as follows:

Brighton, September 7, 1796.

SIR,

My dear daughter, as well as my whole family, have every thing to thank you for. The morning we left Clifton, turned out very bad. We had wind and rain nearly all the way to Oxford; what increased our fears most was, we lost the air from the air-holder, it being unsoldered. We spent the next day there, and although the weather continued very indifferent, to my great surprize my daughter remained well.

The day following we reached home, and waited with anxiety for the apparatus, fearful of the return of the complaint, but to our great joy I assure you she has not had a fit since. We have continued the use of the air, except at short intervals, and about two months back took her to Brighton by way of trial, but the second day after our arrival, (the weather was very changeable) perceiving a weakness in her eyes, which I have always considered as a symptom of the old complaint, we returned immediately to our house in Camberwell, where after staying a short time, the weather coming on fine, we came again to this place for another trial, and have the satisfaction to say she has continued well without the use of the oxygen air.

I am, dear Sir, &c.

FRANCIS GREEN.

Observation by Dr. Beddoes.

The two preceding cases came under my own observation. They were among the worst in their kind; and the event, as far as we can perceive at present, has been eminently successful. Mr. Hare and Miss Sarah Green I saw every day for three or four weeks. These the fits were very frequent

and severe; but they were in other respects such as are commonly to be observed in spasmodic asthma. I do not therefore think it necessary to enter into any discussion concerning the symptoms. But there are a few facts which it would be unfair if I were to conceal from the reader. Mr. Hare began with one quart of oxygen air to above twenty of atmospheric, twice a-day—he never exceeded three quarts of oxygen at one dose. The morning after the sixth dose he observed some streaks of blood on a small quantity of mucus, which he had expectorated. This was not attended, nor to the present day, (Sept. 23, 1796, on which I have seen Mr. H. in excellent health) has it been followed by any suspicious symptom. From my idea of the stimulating power of oxygen gas, I felt some alarm, and persuaded my patient to desist from the use of the air for a day or two; and at this moment I believe that I should have advised the entire discontinuance of it; but Mr. H. who laid no stress upon the occurrence, was little disposed even to procrastination; and he expressed a firm resolution to run some risk in order to procure an abatement of his harassing complaint. He accordingly went on respiring diluted oxygen till the time specified in his letter, since which he has not resumed it. Like many other asthmatics, he was particularly liable to catarrh; in consequence of which he never failed to have a paroxysm. Apprehending he had taken cold once or twice during the first fortnight, I ordered him four or five grains of antimonial powder at bed-time. Dr. Thornton*, in consideration of his weakened habit, had before suggested to him the propriety of taking tonic medicines. I did not scruple to order pills of equal parts of extract of gentian and sulphate of iron (green vitriol), of which, after leaving Clifton, Mr. H. took six or eight grains a day for some time. For this twelve-month past he has not taken an atom of any opiate or any antispasmodic medicine. The apparent improvement of this gentleman's constitution is, in my opinion, still more remarkable than the diminished frequency and force of his disorder. Oxygen air has frequently enabled persons to bear cold better; and I have met with no one who seems to have experienced this agreeable change to a greater degree than Mr. Hare. When I was called to Miss S. Green, I found her labouring under an attack of asthma, which with some small remissions, continued three days and nights. Her fits had been of late so severe as to give her friends the idea of immediate danger. Besides oxygen air, she has taken the mineral solution Fowler, ipecacuanha in small doses, and likewise as Mr. Gree informs me, five or six emetics since October, 1795; an emetic having been given when she perceived a huskiness in her throat; I suppose lest a fit of asthma should come on after a catarrh.

* Dr. Turton recommended Mr. Hare to Dr. Thornton, who advised this gentleman, as it was hot weather, to leave London, and inhale the oxygen air under Dr. Beddoes.

ASTHMA.	CIRCUMSTANCES.
Case XXIV. Boothby Clopton, Esq. under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 21.	*Mr. Boothby Clopton's replies to Queries respecting his personal experience of the inhalation of vital air.* *Letter to Dr. Beddoes from Dr. Thornton.* Duke-street, Grosvenor-square, July 18, 1795. It is with great pleasure I send you the enclosed letter proposing queries to Mr. Boothby Clopton.

Dr. Thornton's letter to Mr. Clopton.

SIR,

As Sir William Chambers, and other Gentlemen of rank and character in England, have consented to authenticate the effects of the vital and other aerial remedies on themselves, and as my motive for this application is no other than the extension of the most important of the sciences, I am emboldened to request the same favour of you. You, Sir, are so well known to move in the highest sphere of life, that your testimony will greatly contribute to draw attention towards an investigation, which I have no doubt will *finally* be productive of much general good. Permit me then to request your answer to the following queries.

1. What was the nature of your indisposition?

Ans. Asthma, accompanied with great debility.

2. How long had you been ill previous to your coming under my care?

Ans. Seven months.

3. Did the Gentleman who attended you, make any objection to your trying the vital air, or did he suppose other medicines would have had equal efficacy?

Ans. Sir Walter Farquhar had no objection, medicines having been so long used without effect.

4. Was the disease after a time alleviated?

Ans. Immediately on my inhaling the air, I was less oppressed with asthma, and slept better the first night than I had done for seven months.

5. Did you find any alteration in your strength and spirits?

Ans. My strength and spirits were certainly increased.

6. Did your friends observe any alteration in your countenance?

Ans. Not only in my countenance, but in my person, for my nights being rendered good, I increased considerably in weight.

7. Has the advantage been permanent?

Ans. I inhaled the vital air in the winter, and am now in perfect health; and as I took no medicine, I am convinced my recovery proceeds solely from inhaling the vital air.

ASTHMA.	CIRCUMSTANCES
Case XXV. Rev. Dr. B——, under Dr. Thornton, cured. Vide the Rev. Mr. Townsend's Guide to Health, Vol. I. p. 398.	The Rev. Dr. B——, an intimate friend of the celebrated oculist Mr. Wathen, had for more than two years been afflicted with asthma. The paroxysms were singularly severe, so that he could not breathe but in a contorted position of his body; they recurred regularly each night, and lasted in general from five to seven hours. Being quite exhausted, he would at length fall

asleep, but awoke with a parched tongue and very languid.

He had been under the care of several very eminent physicians, and latterly under Dr. Warren, who told him, with his accustomed liberality, that he was persuaded, from a very extensive experience, that asthma, when once fixed in the habit, was not to be removed by art, however it might be palliated, and he must not therefore entertain the fallacious hope of a cure from medicine, and fly from physician to physician, but must patiently resign himself to the affliction. But daily losing flesh and strength, his family began to be very apprehensive, and Mr. Wathen having told them of the extraordinary relief and final cure, obtained by a young lady of his acquaintance, in the most violent spasmodic attacks*, when the prescriptions of the ablest physicians could render her no service, and that an asthma even of forty years standing had been greatly relieved by the inhalation of the vital air, this gentleman was encouraged to confide himself to the care of Dr. Thornton.

In ten days time, by cleansing the stomach of viscid mucus, and restoring the vital principle to the blood, his paroxysms were somewhat less violent; after which, by strengthening the system, and still continuing the inhalation of an oxygenated atmosphere, he had several intermissions, and in two months he was perfectly free from asthma.

He continued throughout the whole of last winter perfectly well, and at the present time is, as Mr. Wathen informs me, in the full enjoyment of the blessing of health.

* Vide Case XXXIV.

ASTHMA.	CIRCUMSTANCES.

Case XXVI.
Mr. Stepney's two servants, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 50.

A letter from Mr. Phipps, Surgeon and Oculist in Ordinary to his Majesty, to Dr. Beddoes.

Pall-Mall, August 8, 1796.

SIR,

Mr. Stepney having mentioned to me that a servant who attended him had been afflicted with a spasmodic asthma above thirty years, I recommended Mr. S. to place him under the care of Dr. Thornton. Accordingly he did so. He was ordered a more generous mode of living; and whenever his disease has threatened an approach, it has been invariably put off by inhalation of vital air. During the last eight months, he has had but two paroxysms, which were so slight as not to confine him to his bed, as formerly; and I should add that his son, who, upwards of seven years, had constant dyspnœa, with frequent spasmodic attacks of asthma, was also cured four months ago by the same remedy in seven days, and when I saw him lately he was blooming, and in perfect health.

I remain, Sir, &c.

J. W. PHIPPS.

Case XXVII.
Mrs. Barrett, under Dr. Thornton, cured. Vide Dr. Beddoes's Considerations, Part III. page 26.

A letter from Mrs. Barrett to Dr. Beddoes.

Queen-square, Westminster, July 12, 1795.

SIR,

My asthma had afflicted me three years. It attacked me very violently at times, the fit going off generally with expectoration, leaving me very low and weak. The last winter it was uncommonly severe, and latterly, for months, I had not known what it was to enjoy a comfortable night's rest. As a tradesman in our neighbourhood had been just cured by Dr. Thornton, by means of vital air, of an asthma of thirteen years standing, I resolved to put myself under that physician's care, though before this, I had made up my mind to try no more medicines. I inhaled the vital air from a large bell glass, and its effect was so immediate, that on the [illegible]d night I slept the whole night through. My attacks were [illegible] less frequent, and milder, and pursuing the vital air for six weeks, I got free of my complaint. With the blessing of God, I have continued since in perfect health, except I catch a bad cold, when my asthma recurs, but then in a very slight degree.

I am, Sir,

Your obedient humble servant,

ELIZ. BARRETT.

Observations on this Case by Dr. Thornton.

The tradesman, whom Mrs. Barrett mentions in her letter, is a baker in Tothil-street. He certainly obtained considerable benefit, and when I sent on the 20th of July, 1795, to enquire how he continued; the answer returned was, "that he had not enjoyed such health, as at present, for years."

ASTHMA	CIRCUMSTANCES
Case XXVIII. Mrs. Howlet, under Dr. Redfearn, cured. Vide Dr Beddoes' Considerations, Part II. page 28.	*Letter from Dr. Redfearn to Dr. Beddoes.*

Lynn, Norfolk, Oct. 1, 1795

SIR,

Elizabeth Howlet, aged 41 years, has been afflicted with a pituitous asthma upwards of sixteen years, attended with dyspnœa, troublesome cough, and a copious expectoration. She is also subject to flatulency, loss of appetite, and has great debility. Her countenance is pale and somewhat bloated; her pulse was 100, weak and tremulous. Last May she began to inhale four quarts of oxygen diluted with eighteen of atmospheric air, every evening. The oxygen was gradually increased, and during the last two months, she has inhaled daily twelve quarts of oxygen mixed with ten of atmospheric air. Sometimes she has inhaled a cubic foot of recent oxygen undiluted, without experiencing any bad effects from it. She only mentioned a sensation similar to that from drinking peppermint water, and an agreeable glow in her chest, and after inhaling this quantity her sleep was always sound and undisturbed by coughing. September 20, she now relinquished the inhalation with much regret, after having used it for four months. The dyspeptic symptoms are entirely removed, and she is now enabled to make her own bed, which she had not been able to do for *ten years past*; she has also acquired a degree of corpulency which has surprised all her friends, and the livid appearance at the extremities of her fingers has totally disappeared; her cough and expectoration are much mitigated; and her countenance appears more healthy than before; her pulse is now about 70, natural, and increased in vigour; her appetite is very good, and she sleeps well.

XI. DYSPNŒA.

	CIRCUMSTANCES.
Case XXIX. Mrs. ——, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 29.	*Letter from Mr. Phipps, Surgeon and Oculist in ordinary to the King, to Dr. Beddoes.*

Pall-Mall, Aug 5, 1795.

SIR,

Understanding that you are collecting accounts of the various effects either seen or felt from the vital air, I embrace the present opportunity of transmitting the result of two cases which came under my particular notice. I was first induced to recommend the vital air, from observing the very happy and immediate effect it had in removing violent spasms which had resisted, in a relation of mine, all medicines for above three years*. Soon after, a very corpulent lady, of about 60 years of age, applied to me for a chronic inflammation in her eyes: besides which, I found she laboured under the greatest possible difficulty in breathing. She could not even walk from the coach into the house, without stopping more than once to recover her breath. After ordering what appeared to me necessary for her ophthalmia, I recommended her to the care of Dr. Thornton for her dyspnœa, requesting to see her in a week. In this short space of time the amendment greatly exceeded my expectations. She had walked above a mile to my house; her respiration had become almost free; and her nights better than she had enjoyed for a long time. She continued the use of the oxygen air for a month, and was most perfectly cured, and has never had any relapse.

I remain, Sir,
Your obedient servant,
J. W. PHIPPS.

Case XXX. Mr. Colvin, under Dr. Thornton, relieved. Vide Dr. Beddoes' Considerations, Part IV. page 69.	*Letter to Dr. Beddoes.*

Duke-street, Grosvenor-square, July 2, 1796.

DEAR SIR,

The subject of this report is a very corpulent gentleman, who had been afflicted, more or less, with dyspnœa for twenty years, and under different physicians with little or no alleviation of his complaint. Mr. Colvin had commonly but small appetite; was troubled with dyspepsia; and of a costive habit of body. Upon coming up stairs he was accustomed, as he gave at first evident demonstration, greatly to puff and blow; having, as he

* Vide Case XXXIV.

expressed himself, no wind. He was troubled with lowness of spirits; his body was distended; and his nights were so disturbed, that he seldom slept three hours together. After he had been under my care but a fortnight, he came with his partner, Mr. Lowndes, a liquor-merchant at Temple-Bar, who assured me, that he thought Mr. Colvin was better than he had seen him these last eighteen years. Having inhaled six quarts of vital air mixed with thirty of atmospheric, he felt, as was ever afterwards the case, the easiest respiration a genial glow with perspiration; vigour, and lightsomeness; or in a word, for these are his own expressions, the sensation of indescribable health. Upon asking him, whether he perceived he was stronger? in an energetic tone of voice, he declared, "he felt five times as strong;" he added also, that his appetite was returned; and his sleep was undisturbed and continued throughout the night. He then went down stairs in the presence of Mr. Lowndes and Mr. Curtis, the son of an eminent surgeon at Chiswick, and having come quickly up stairs, he was able freely to discourse with us immediately, which Mr. Lowndes declared he had not done for years.

DYSPNŒA.	CIRCUMSTANCES.
Case XXXI. Mr. A——, under Dr. Thornton, relieved. Vide Dr. Beddoes' Considerations, Part IV. page 61.	*Letter from Dr. Thornton to Dr. Reynolds.* SIR, In the Spring succeeding the severe Winter of 1795, which was characterized by inflammations of the chest, the patient you did me the honor to confide to my care suffered with others. The apothecary, who at that time attended, neither bled or blistered

him. As the sequel to this inflammatory attack, he has been subject to dyspnœa, more especially upon using the slightest exercise. Now, my dear Sir, in such unfortunate subjects, where the lungs were inflamed, I have found, upon dissection, obliterated air-cells, and, where the pleura was the seat of the inflammation, numerous adhesions. In either case little can be done or expected from medicine. Nevertheless, as the disease might be palliated, and the constitution strengthened, by the inhalation of an atmosphere of a higher standard, the trial was authorized, and the case is beautiful in itself, as throwing considerable light on the subject of respiration. Mr. A. before the inflammatory attack on his lungs, was florid, and of a clear complexion: he had once even hæmoptoe; now his cheeks are devoid of colour, and his aspect extremely bilious. Before heat was insufferable; now he enjoys a fire even in the midst of Summer. Before, his pulse, as he informs me, was accounted full; now it vibrates feebly and quickly. Whilst he inhales a superoxygenated atmosphere, he always feels his respiration easy;

his parched hands become sensibly moist; he has a glow and tingling sensation in his fingers; and as Dr. Haighton, the celebrated lecturer on Physiology at Guy's-Hospital, noticed, his pulse is rendered both slower and considerably fuller. Immediately af[illegible] this easy process, he has obligingly gone down stairs, and upon com[illegible] up again, he has breathed perfectly free, as many spe[illegible]tors [illegible] witnessed. In this case might not a constant inh[illegible] [illegible]phere of a higher standard produce the mo[illegible] certain [illegible] service? but this, my dear Sir, is reser[illegible] for a [illegible]ed state of the Pneumatic practice, when rooms [illegible] [illegible]ted up for that purpose.

I have the honor to be, &c. &c.

R. J. THORNTON.

DISEASE.	CIRCUMSTANCES.
Case XXXII. Rev. Mr. F——, under Dr. Beddoes, relieved. Vide Dr. Beddoes' Considerations, Part I. page 80.	This gentleman, when at Bristol Hotwells, being much troubled with dyspnœa and mucous expectoration, used to assure me, that after inhaling diluted oxygen air, he could walk up the steep hill to Clifton, with much greater ease than at other times. He made the experiment innumerable times. This air, however, rendered him no permanent benefit, his disorder depending upon mal-confirmation.
Case XXXIII. Mr. Yonge. His experiment. Vide Dr. Beddoes' Considerations, Part III. p. 30.	August 27, 1795. I tried, by way of experiment, how long I could retain one inspiration of common atmospheric air, with a stop-watch before me, and found it to be 20 seconds. I then inhaled common air mixed with nearly an equal part of oxygen air, which I suppose enabled me to retain it 32 seconds. Lastly, I inhaled oxygen, such as manganese yields. This was retained, by nearly the same effort, 55 seconds. GUSTAVUS YONGE.

XII. SPASMS OF THE DIAPHRAGM.

	CIRCUMSTANCES.
[illegible] XXXIV. Miss S——, under Dr. Thornton, [illegible]ed. Vide Dr. [illegible]does' Conside[illegible]tions, Part IV, page 51.	*Letter from Mr. Phipps, Surgeon and Oculist in ordinary to his Majesty, to Dr. Beddoes.* Pall-Mall, August 8, 1796. DEAR SIR, I have just received a letter containing a request of yours, that I would send a particular account of the case of a young lady who had been cured of violent spasms, by

means of oxygen air. I heartily wish it were in my power to do it with more minuteness, but I kept no journal of the case. The lady had for nearly three years prior to her inhaling the oxygen, been afflicted with spasms in her side, and indeed, through the whole extent of the diaphragm, which appeared to me the immediate seat of the complaint. For the first two years they were not constant, and only slight, very bearable, and easily removed by a few drops of laudanum. During the last year, they encreased to a degree truly terrific. She was now never totally free from pain; and generally, morning and evening, the spasms became so dreadful, that I cannot find words to convey an idea of them. They would continue half an hour, one, two, three, and even six and eight hours. Laudanum, to the quantity of three hundred drops, produced no other effect than to render her perfectly delirious. Her breath was also at this time so much affected, that she could not go up or down stairs without resting every two or three steps, and panting to a degree that was frightful. In this state (during the spasm) she first breathed oxygen air by the direction of Dr. Thornton, in the proportion of about three pints to twelve or fourteen of atmospheric air, and it almost instantaneously removed the spasm. This same effect was generally obtained, and there were two and three days sometimes together during which she had no strong spasm: nor do I think, after the first week of inhaling the oxygen air, they ever returned with the same degree of violence. I found it necessary, however, to encrease the quantity of oxygen to about six pints with the same proportion of atmospheric air. Thus I gave it constantly at the commencement of the spasm, and always with effect; sometimes complete, and sometimes only so far successful as to render the spasm tolerable. After about three months there was a considerable amendment, the spasms were slight and less frequent. She soon after married, and had not the least return for a year and a half; at the end of that period she had some spasmodic feelings, but they were slight, and of short duration: since (this is two years since) she has been perfectly well. These, I believe, are the leading features of the case, and I only wish I could have transmitted them to you with greater particularity. I have this morning seen the lad I mentioned in my last, as cured of asthma, he has had no return whatever, and it is now more than three months since he left off the vital air, which he inhaled for six weeks. I have only to add, that

I have the honor to be,

Your's, &c.

J. W. PHIPPS.

XIII. DYSPEPSIA, OR WEAKNESS OF THE STOMACH.

DYSPEPSIA.	CIRCUMSTANCES.
Case XXXV. Mr. Cotterel, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 65.	*Letter from Mr. Cotterel to Dr. Beddoes.* King-street, Westminster, Dec. 3, 1795. SIR, I was troubled with great flatulence, heartburn, want of relish to my food, lowness of spirits, coldness of the hands and feet, and had slept very ill for more than five years.

Before this time I enjoyed very good health; and to be employed in my occupation for my wife and family was a delight, but now it was attended with extreme uneasiness to myself. I was under the care of Dr. Lister, Dr. Pitcairne, and other medical gentlemen of the first eminence. I had taken a great load of bark and other medicines, and during these five years I changed first from one physician and then to another, and tried what different friends recommended, but in the end I only grew worse. Having consulted Dr. Thornton, he gave me some hopes, and by his direction I inhaled the vital air, and drank three times a day water impregnated with fixed air, in which I dropt thirty drops of æther three times a day. In a fortnight I was free from my complaint, but I continued for some time the water impregnated with the fixed air, in which some salt of steel had been dissolved, and I have since occasionally chewed a warm aromatic root, and for these last two years have enjoyed very good health.

I am, Sir, &c.

MATTHEW COTTEREL.

DYSPEPSIA.	CIRCUMSTANCES.
Case XXXVI. Mrs. Broomhall, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 66.	*Letter from Mrs. Broomhall to Dr. Beddoes.* Stanhope-street, Jan. 1, 1795. SIR, December 5, 1793, when I came under Dr. Thornton's care, I had a bad digestion, and a nervous headache so intolerable, to which I had been subject above three years, that I believe, had I not been cured, I must

have lost my senses. I inhaled the vital air, and by Dr. Thornton's order, I took an electuary of bark and steel, three times a day, having been first prepared for that medicine. From the

first I gradually grew better, acquiring both strength and appetite, and in proportion as these improved, my head-aches were diminished. I have had no return of head-ache, or want of appetite, and enjoy at the present moment very good health.

I am, Sir, &c.

ELIZ. BROOMHALL.

DYSPEPSIA. CIRCUMSTANCES.

Case XXXVII. Mary Hodder, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 131.

This patient, aged 39, lives a servant to Mrs. Godfrey, No. 74, Piccadilly, has for seven years laboured under sickness at the stomach, frequent retchings, great heat and pain at the pit of the stomach, and flashings of the face after eating; drowsiness, a briny water would often flow into the mouth, emaciation, great debility, horrid dreams, often waking in excessive fright, and commonly with a dull head-ache. She would faint away after any uneasiness and fatigue, and remain for five or ten minutes like a dead person; feet and legs extremely cold, subject to flatulence, extremely costive, sight impaired; and, on account of her ill health, she was obliged to leave three places. She was turned out uncured twice from an hospital, and once from a dispensary; and had tried private practitioners without benefit. Of late the symptoms of her disorder had rather increased; when she began the inhalation of the vital air. In three weeks, by the power of this remedy, conjoined with emetics, cathartics, bark, and steel, she became perfectly free from sickness, appetite returned, sleep was undisturbed by frightful dreams, perspiration restored, a genial glow in the extremities, countenance became healthy, and strength so far increased, that she feels herself perfectly adequate to her present situation. The air has been left off, and the amendment continues. The quantity of air inhaled daily, was six quarts of vital air to thirty of atmospheric air.

Case XXXVIII. Mr. Page, under Dr. Thornton, relieved. Vide Mr. Townsend's Guide to Health, Vol. I. page 277.

— Page, Esq. Member for Oxford, laboured under so dreadful an irritability of the stomach, or perhaps frequent spasm of that and the adjacent parts, that upon eating, he was almost constantly seized with vomiting, which latterly became so frequent, that nothing would stay on his stomach.

In this distressing moment, Dr. Thornton was sent for. The oxygen gas, with a certain portion of atmospheric air, was inhaled, and the balance being made on the side of oxygen, Dr. Thornton requested his patient to take some sustenance, which he had not done for many hours. Mr. Page refused it at first, as he was certain it would bring on him a renewal

of his distress. But being persuaded by Dr. Thornton and his apothecary, Mr. Wood, to make the trial, he was pleasantly surprised on suddenly experiencing the power of a new remedy, and he declared he was convinced, from the experience he had of different medicines, that no other means could have produced the same effect. He continued free from sickness as often as the oxygen air in a diluted form was administered.

DYSPEPSIA.	CIRCUMSTANCES.
Case XXXIX. Mrs. Appleby, under Dr. Harrison and Dr. Darling, cured. Vide Philosophical Magazine, Number VIII. p. 420.	Mrs. Appleby, wife of the Rev. William Appleby, at Wooten, Lincolnshire, laboured under dyspeptic complaints upwards of twelve years. Nine physicians had tried their art, but to no purpose. The disorder seemed to gain ground, and was accompanied with violent spasms and a paralysis of her lower extremities. Dr. Harrison of Horncastle, who last attended her, desired

she would try the oxygenating system; and conjointly with Dr. Darling of Glandford Bridge, it was effected in this manner. Bark and oxymuriate of potash were given, and oxygen air inhaled; and the change produced was so great, that to the surprise of the whole neighbourhood, this lady was very soon perfectly restored.

XIV. AN ENLARGEMENT OF THE LIVER.

	CIRCUMSTANCES.
Case XL. Mr. ——, under Dr. Thornton, cured. Vide the Philosophical Magazine, Number XVII. page 94.	*Communicated by Dr. Thornton.* The butler of Colonel Ironside, who had been long resident in India, laboured for several years under a well-marked liver complaint. He had been under the care of Dr. Warren, and other physicians, without experiencing any essential advantage. Colonel Ironside, as all other means had

wished him to try the vital air. He ac-

care, and the same tonics were em-

taken; therefore I ascribe the cure

ed with these, and which

nd he has continued

Observations by Dr. Thornton.

When animals placed in pure vital air were destroyed by so powerful a stimulus, Dr. Beddoes found the liver not liver-coloured, but of a florid red. We therefore can easily suppose it to affect this organ when given in a moderate way: and as the oxyds of mercury and the nitrous acid, which are the best remedies for this disease, act chiefly from their contained oxygen, it is probable that the vital air will hereafter be found a specific in this complaint, possessing superior advantages over both these remedies, and will supersede them, although it cannot be put up into two-ounce phials, the principal objection raised against it; for the airs can now (which originated from my suggestion) be confined in barrels, and bottled off as easily as wine; and I must observe, that this patient had a barrel of vital air, containing 24 gallons, which cost him one guinea, conveyed for him to his master's seat in the country, and a tin pneumatic apparatus for inhaling the medicinal air, which stood him at the low rate of thirty shillings: which improvements, I trust, will greatly facilitate the general application of pneumatic medicine, when it will be sure to find that rank its merits entitle it to.

XV. ASCITES, OR DROPSY OF THE ABDOMEN.

	CIRCUMSTANCES.
Case XLI. Sarah Kimber, under Dr. Thornton, cured. Vide Townsend's Elements, Vol. II. page 274.	Sarah Kimber, aged eight years, living at No. 10, Wood-street, Spa-place, Clerkenwell, with the usual symptoms of dropsy, had her belly very much distended, and upon pressure there was an evident fluctuation of water. This disorder had subsisted more than two years, and, notwithstanding the use of a variety of remedies, it went on constantly increasing, till her physician (Dr. Myers) gave up all hopes of her surviving many days; in this stage of the disease, my able friend Dr. Thornton was consulted. He began with an emetic, and the subsequent day he gave a brisk cathartic of rhubarb with a neutral salt. He applied a tight bandage of flannel about the abdomen, and ordered the strong mercurial ointment to be rubbed in each evening. He put her upon milk diet, with onion and toasted bread for supper. In a few days the emetic was repeated, and when the mouth became sore, she had for two mornings brisk saline cathartics. He then gave bark and myrrh in port wine twice a day, assisted in their operation by the inhalation of vital air. These powerful tonics were accompanied with swinging until nausea or sickness was

produced, and at night she took half a grain of opium. At the end of only ten days, in consequence of this mode of treatment, the belly was diminished more than one half, her spirits revived, and her friends remarked of her, that "she skipped about the house as brisk as a bee." After fifteen days, emetics at intervals, with saline cathartics, and the mercurial ointment, were repeated; the opium pill at night, and the tight bandage were still continued. Chalybeates were then thrown in, and the emetics with cathartics were employed at more distant intervals, in consequence of which her complexion assumed the rosy blush of health; she was now able to vie with her companions in running, and the recurrence of the disease was prevented.

XVI. CHLOROSIS, OR WANT OF FEMALE RELIEF.

CIRCUMSTANCES.

Case XLII. Miss ——, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III.

Letter from Mrs. Stephens to Dr. Beddoes.

Snow-Hill, August 6, 1795.

SIR,

A young lady, an acquaintance of mine, aged 20, having been two years ill, and under Dr. Carr, an eminent physician, at Northampton; but continuing in the same state, was sent on a visit to me, in order that she might obtain the opinion of some physician in London. Having had the pleasure to see the greatest [illegible] derived by the daughter of Sir W. D. whose case was somewhat similar, from the inhalation of the vital air, I was very anxious for her to make trial of the same means. The countenance of Miss S—— was pale in the extreme; her lips very white; her breathing short; she was incapable of the smallest exercise; so wearied was she in dressing herself, that even during this trifling exertion, she was obliged repeatedly to lie down; her appetite was very indifferent; her spirits low; she constantly complained of cold; and towards evening her legs used to swell. When we first went to Dr. Thornton's we were obliged to take a coach there and back, and even the getting out and in, and going up stairs, seemed too much for her. At the end of five days, the change in her strength was so great, that she was able to walk back near a mile and half, and in getting up stairs, instead of panting for breath at every four or five steps, she could ascend the whole flight with the greatest speed and ease. Her appetite was good; her spirits raised; her countenance shewed the signs of returning health; and her lips, cheeks, and nails, assumed a faint blush, which continued increasing, until she was in every particular

particular restored to perfect health, and could walk to and back from Dr. Thornton's, above three miles, with the utmost ease, when Miss S——, after staying with me five weeks, returned to her friends, every one was astonished at the great alteration, and indeed she hardly appeared the same person.

I am, Sir,

Your obedient humble Servant,

CAROLINE STEPHENS.

Observations on this Case by Dr. Thornton.

1. Did not the pallid countenance; the white lip and tongue; the dyspnœa when in action; the semipellucid and polished skin; the want of perspiration; the black and pearly eye; the coldness of the frame; the dyspepsia; the yellow appearance of the teeth; the lowness of spirits; the weak and quick pulse; denote a deficiency of oxygen in the system?

2. If the skin was torn (before the system was oxygenated) there would ooze from the scratch, not blood, but a yellow serum. Is not the predominance of this fluid, the cause of that sallowness of the countenance so frequently mistaken for a disease of the liver, whence these persons have the name of bilious?

CHLOROSIS.	CIRCUMSTANCES.
Case XLIII. Miss Lambert under Dr. Alderson, cured. Vide Dr. Beddoes' Considerations, Part III. page 57.	*Letter from Dr. Alderson, to Dr. Beddoes.*

Hull, June 26, 1795.

DEAR SIR,

I was in 1793 called to meet Dr. B——, in the case of Miss L——, aged 17, who had been long labouring under chlorosis. As my colleague had been for some time administering a variety of very proper tonics, and being at that time persuaded that some preparation of steel would effect a cure, I advised only a different preparation of that mineral; but the change not producing the desired effect, the doctor wished some blood to be drawn from the arm, in the hopes that after the evacuation the tonics would have a better effect.—The blood was remarkably pale, and afforded but very little crassamentum indeed; no alteration took place in the system for the better; she then went to sea, and returned from her voyage somewhat better; but soon after relapsed, and the complaint being now attended with great emaciation, and an uncommon throbbing in the carotids, which upon lying down was so very troublesome as to prevent her sleeping, my assistance was again called in, and having no prejudices to overcome with her very ingenious father, I immediately proposed the inha-

lation of oxygen air; the first effect of which was to take off the throbbing of the arteries, enabling her to lie down and to get quiet sleep; the other effects are concisely related by her father, in his letter to me, of which the enclosed is a copy.

I am, Sir,

Your obedient Servant,

J. ALDERSON.

Letter from Mr. Lambert to Dr. Alderson.

Hull, June 5, 1795.

SIR,

It is not necessary that I should attempt to describe after you, the nature of my daughter Elizabeth's complaint, or to enumerate the various medicines that had been administered prior to your ordering the vital air. I shall therefore only mention, that the immediate effect produced by this, was a considerable exhilaration of her spirits: in a few days the violent beating in her head greatly abated—the ends of her fingers began to assume their natural colour; and, by a steady perseverance in the use of it for about three months, together with salt of steel, from a state of the greatest debility, and an appearance the most unhealthy, she assumed her former colour, strength, and vigour. With the deepest sense of my great obligation to you,

I remain, Sir,

Your very humble Servant,

GEORGE LAMBERT.

CHLOROSIS. | CIRCUMSTANCES.

Case XLIV.
Miss L——, under Dr. Emerson, cured. Vide Dr. Beddoes' Considerations, Part IV. page 66.

Swa[illegible] August 15, 1796.

Miss L. G. 19 years of age, had a suppression of the menses for more than 2 years. Her countenance was pale in the extreme, lips white, appetite impaired, general sensation of coldness, and aversion to exercise. Chalybeates, with other deobstruent and aperient medicines, were directed for her;—as these had been continued for three weeks without the desired success, she inhaled on the 20th of January, 1796, a mixture of three quarts of oxygen and 19 quarts of atmospheric air. It was administered only once a day, and in less than a week the patient was enabled to walk nearly three miles every morning for that purpose, with great ease, which she could not do at first without much fatigue; she attended afterwards with less regularity, not more than 12 doses having been inhaled in three weeks. She was sensible of its exhilarating effects, and derived a most remarkable degree of advantage from so small a number of inhalations. Her cheeks and lips acquired the ruddy glow of health,

the appetite was perfectly restored, and indolence and lassitude were succeeded by activity and spirits. She had not experienced (her own expression) so good a state of health for two or three years. The period had not, however, returned at the time she discontinued the oxygen, but she has since continued in perfect health.

R. EMERSON.

CHLOROSIS. CIRCUMSTANCES

Case XLV. Elizabeth Byworth, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 67.

Letter from Dr. Thornton to Dr. Beddoes.

Duke-street, Grosvenor-square, Aug. 26, 1791

SIR,

Elizabeth Byworth, aged 17, was in service at Mr. Long's, New-Wharf, White-Friars, when from catching cold, the natural female relief forsook her, and she became subject to frequent hysterics; her countenance was bilious; she had qualmy sickness in the morning; appetite irregular; dyspnœa upon the slightest exercise, to which she felt extremely disinclined; and so great debility that she was unable to maintain her place. To these symptoms succeeded fainting, three or four times a day; a continued disturbance in the intestinal canal; spongy gums; towards evening, chilliness; but more frequently much external heat; no perspiration; and an irregular exoneration of the bowels. Notwithstanding the methods employed, this complaint remained above three years, during which time she lived with her mother, No. 6, Water-lane, Fleet-street. In getting from thence to Duke-street, she was above two hours, and was quite exhausted with fatigue. She continued as a patient five weeks, during which time she took two emetics, aloetic and steel pills, and she inhaled daily thirty quarts of atmospheric air, super-oxygenated with six quarts of vital air; at the end of less than four weeks she was able to walk here without fatigue in three quarters of an hour; she had no sickness at the stomach in the morning; could go up an ascent without stopping, or scarcely panting; the gums ceased to bleed; the appetite was constant; the lips were red; the pulse bold and regular, instead of being quick and thready; her natural perspiration returned; and the complexion was so ameliorated, that the change did not fail to be noticed by every one. She has since gone to live as servant in a family in Old-street, being now in every respect in perfect health, and adequate to the situation.

From, Sir, your's sincerely,

R. J. THORNTON.

XVII. HYSTERIA. HYSTERIC AFFECTION.

	CIRCUMSTANCES.
Case XLVI. Miss M——, under Dr. Thornton, cured. Vide Mr. Townsend's Elements of Therapeuticks, Vol. II. page 12.	When I was in London last winter, I had the pleasure of meeting, at the house of my ingenious friend Dr. Thornton, an amiable young lady, who spoke with rapture, of the benefits she had received from the vital air. Since her arrival from Italy, which was two years ago, in the vicissitudes of this climate, she early experienced a considerable diminution of strength, appetite, and spirits.

She took, in consequence, a vast quantity of bark, steel, and other tonics, under various physicians, but with no alleviation of the symptoms. When she became a patient to Dr. Thornton, she was so weak, as scarcely to be able to walk across the room; she was subject to hysteric fits, which occurred seldom less than three or four times each day; and the least angry word, or slightest contradiction, excited a flood of tears. Her feet were cold as ice; but after taking food, more especially if she used an acid, she had heat and flushings of the face, while the rest of the body remained nearly as cold as her extremities.

Having the greatest aversion to every kind of medicine, she made trial only of the vital air, except an occasional aperient draught of rhubarb and vitriolated kali in some peppermint water. In a fortnight, by the daily inhalation of vital air mixed with atmospheric, the hysteric fits returned no more: her appetite improved; her spirits rose; cold was less severely felt; and her strength was so far increased, that she was able, after a fortnight, to walk near a mile, to attend on Dr. Thornton. If at any time she left off for a few days the inhalation of the vital air, she experienced the most uncomfortable sensation of cold, and less muscular powers, with pain in her stomach; all which symptoms were removed as often as she recurred to the use of vital air. She inhaled the medicinal air during the whole of the last severe winter, continued it at intervals in the spring, used the shower-bath in the summer, and in the autumn she was in excellent health.

XVIII. QUALMS OF PREGNANCY.

	CIRCUMSTANCES.
Case XLVII. Mrs. ——, under Dr. Thornton, relieved. Vide Dr. Beddoes' Considerations, Part III. page 115.	*Letter from Dr. Thornton to Dr Beddoes.*

Duke-street, Grosvenor-square, August 6, 1795

DEAR SIR,

I cannot better close this year my experience respecting the effects of vital air than by the trial I have made of it in pregnancy. It had been before remarked, that pregnancy often arrests consumption, but to you first we are indebted for an attempt to explain the manner in which this effect is produced. Allow me to lay your ideas before the reader. "The fœtus has its blood oxygenated by the blood of the mother through the placenta.—During pregnancy there seems to be no provision for the reception of an unusual quantity of oxygen. On the contrary, in consequence of the impeded action of the diaphragm, less and less should be taken into the lungs. The dark colour of the blood; the aching of the teeth, and bleeding of the gums; the propensity to break out into sores, their dark appearance, and difficulty in healing; the dislike to animal food, and desire of acids and vegetables; also the black appearance of the areolæ of the breasts, peculiar to that period; and the sallowness of the countenance, seem to indicate a defect of oxygen." In the present case, most of these symptoms were strongly marked; they were accompanied with great dyspepsia and lowness of spirits. As with those under the influence of wine (the theory of which we before had occasion to consider, page 36), there was defect of appetite in the morning, with nausea and frequent inclination to vomiting. Instead of arterial, although the lady was in the vigour of life, there was venous plethora, and she complained of universal chilliness. I observed that acid fruits and vinegar were so much indulged in, as in another state of the frame must have produced great evil. This indulgence was not however previous, but subsequent to the symptoms above described, and so far from augmenting, seemed rather to lessen them.—Any smell tending to putrescency would occasion a total derangement in her constitution. Salt of vinegar and acids were very reviving, and would almost instantly stay the inclination to vomiting. In this state a violent fright produced first fainting, and then convulsive fits; these alterations would afterwards appear at uncertain intervals, and last from two to three hours. Wine, laudanum, peppermint, and brandy, seemed the most salutary remedies, either by being a stimulus adapted to the torpor of the system at that period; or else from the consent which this oc-

casions with the lungs, a larger portion of vital air was in consequence imbibed by the blood flowing through that organ. As things were thus circumstanced, I thought of the vital air, and your theory authorised me to make this delicate and interesting trial. Therefore, during one of these paroxysms, peppermint-water and wine being first ineffectually administered, the room was sprinkled with vinegar, I then pressed into the lungs super-oxygenated air, and in a few minutes there was a most evident alteration for the better. This lady being so speedily recovered, the super-oxygenated air was inhaled afterwards for several days, and it seemed to bring back the frame to the natural state of health, but I chose not to persist in the use of an unknown power in so delicate a situation, unless urged by the strongest indications. The lady has since been delivered of a very fine boy.

Ever your's,

R. J. THORNTON.

XIX. PARALYSIS, OR ENTIRE LOSS OF MUSCULAR POWER.

CIRCUMSTANCES.

Case XLVIII. Captain Hemsley, under Mr. Kentish, cured. Vide Dr. Beddoes' Considerations, Part IV. page 3.

Letter to Dr. Beddoes.

SIR,

Captain Hemsley, ætat. 24, commanded a transport in the service of Government, which went to the West-Indies with Sir Charles Grey's expedition. The company consisted of seventeen men and boys, fourteen of whom died from the ravages of the yellow fever. In the month of June, 1795, he was attacked by the same fever; but being ordered to England, the ship was re-manned, and during his being ill of the fever, the ship sailed. As ships, by steering to the north, quickly change their climate, it produced such an effect upon him, that his existence was preserved; it could hardly be termed more: the use of the lower limbs was entirely lost, and the mental faculties were so much impaired, as to make his friends despair of his recovering his powers either of body or mind. In this state he arrived in England in August, 1795, and was under the care of the faculty at Gosport for about six weeks. After ineffectually using every means recommended by them, they advised his father to take him to Bath, instead of which he put him on board a vessel, and brought him to Sunderland. In the beginning of December, 1795, his father brought him to Newcastle, to see if the use of the vapour bath would render him any service: his situation, on his arrival here, was nearly as above stated: his feet and legs were considerably swelled from extravasated lymph, and the knees contracted

from the rigidity of the flexor tendons: these parts felt below the ordinary temperature of his body, and were very insensible to the touch. Mr. Abbs, with whom I have the pleasure to be connected in business, agreed with me in thinking that the vapour bath might be of use, at least in procuring a relaxation of the rigid tendons; accordingly we ordered him to use the bath three times a week: this he continued for a month, from which he found considerable relief; the swellings of the feet disappearing, and the tendons relaxing, so as to allow every species of motion; but still there was no recovery of voluntary motion, nor any additional power. We gave him calomel in small doses; but so small a quantity affected his mouth, that he received little or no benefit from its use. The bath having performed its duty, by increasing the activity of the absorbents, and restoring flexibility to the joints, not being attended with any further beneficial effects, was desisted from, and the use of tonics, both general and local, were had recourse to; partial bathing to the feet, stimulant liniments, and electricity, wine, bark, and steel; these had an apparent good effect for some days, and then their power seemed to cease; we, therefore, thought of giving the oxygen gas. This being mentioned to a medical friend (Dr. Ramsay), he coincided in the opinion; accordingly, on the 1st of February, 1796, he took two quarts of oxygen, diluted with eighteen of atmospheric air. After drawing in half a dozen inspirations, he found a glow spreading over the whole surface of the lungs, and said he felt as if going to break into a sweat upon the neck and chest. As that part of the nervous system which retained its power, seemed possessed of great mobility, might not this sensation arise from sympathy of the external with the internal surface, as we sometimes observe such consent between the stomach and the skin? The sense of heat continued for about a quarter of an hour, and he felt nothing more from this dose: it was repeated every morning, with his expressing nearly the same sensations. On the fourth morning his urine was much loaded, and deposited a copious sediment, of a reddish flaky matter, resembling brick dust. Sixth day; says he thinks his legs lighter; that is, in lifting up either of his legs, which he does by putting both his hands round his thigh above the knee, he uses less exertion, therefore we hope he has more power of motion in the leg: he has for some years been subject to a scorbutic eruption upon his face, which since his taking the air is rather better, and appears drying with brawny scales. Eighth day; describes the sensation he feels from the circulation of the blood in his leg, which he says sometimes stops suddenly, and then rushes on again; he describes the circulation so accurately, that the internal coats of the vessels appear to give him the sensations which he expresses. Does not this plainly shew that the blood in its passage through the lungs, under the influence of a [illegible]ly oxygenated atmosphere, receives an increased degree of [illegible]ity, which it slowly unfolds to the other parts of the system

The attendants about him observe a great change in his conduct; for though a sailor, he seemed to want the fortitude that class of men are generally possessed of; nor had he that sort of jocularity, but at present his spirits are much better. Tenth day, the glow continues longer, nearly half an hour; the circulating sensation continues, and is much more frequent; his spirits increase, and he says he feels such a change in himself that he begins to have hopes of recovery. Fourteenth day, he gathers strength of body, and his mind partakes, from the same cause, a greater degree of energy; his memory is much more perfect, and his answers are given with such a degree of quickness, in comparison with his manner previous to the taking the air, that he scarce appears the same individual. Sixteenth day, the urine has ceased to deposit, and as his strength encreases, the sympathetic effect upon the skin gradually decreases; he is now enabled to stand with the assistance of crutches and his back supported against the wall. From being so long (seven months) accustomed to lie in bed, and sit on low seats, when standing erect, his head swims like a man upon a precipice, unused to such situations. Eighteenth day, his strength increases in his limbs, and his vertigo not so considerable; can take a few steps sideways upon his crutches, and his back against the wall. Twentieth day, recovers daily; ventures a few steps from the wall upon his crutches; when his stockings are off, his toes are perceived to have a weak voluntary motion; his face continues the same, and his spirits remain good. Twenty-third day, continues to improve; can get off his chair alone, and walks about his room on crutches; expresses a great desire to be allowed to come down stairs, in which he is indulged; it is the first time since he has been here, which is between two and three months; seems highly delighted with the change, as he expresses himself, he feels he gets better every hour; the air in the same quantity (2 quarts to 18) is still continued. Twenty-eighth day, the weather being fine, he is allowed to walk in the garden; the muscular fibre, which was very much relaxed, has greatly recovered its tone, particularly the calves of the legs, which were so soft as more to resemble bags of oil than muscular fibres, are now possessed of that tension which bespeaks health and strength. March 3d, continues to improve, except that his feet and legs are a little stuffed in an evening; as the vapour bath, previous to the use of the air, took away the œdema from the legs, he is to use it again. March 6th. Since he was in the bath his legs have not been so much swelled; in every respect continues to improve; the pulse has not been mentioned in this case, though it was attended to, but in a chronic case it seemed a little necessary; it will be sufficient to remark, that at the time of beginning the use of the oxygen, his pulse was about 100 strokes in a minute, low, and weak; that immediately upon his taking the first dose of gas, his pulse beat from 8 to 10 strokes in a minute slower, and appeared a little more expanded; in the course of

an hour or two it returned to the usual standard, with this difference, that as he gathers strength, the immediate effect is not so great, and that now the usual state of the pulse, instead of being from 100 to 110, is only from 80 to 90. March 10. Continues to get better; can now walk for some time in the garden upon his crutch. March 15. He now uses a great deal more exercise; complains of a numbness of the arm of the right hand. On investigation, this appears to have arisen from his remaining longer than usual upon his crutches, which were not sufficiently stuffed to prevent the compression upon the brachial nerve, and the large vessels of the arm. March 20. From removing the cause of his numbness, the effect has ceased; continues the air, which is now increased to three quarts. April 9. No bad symptoms arising from the continued use of the air, and as at present he appears stationary, it is thought advisable to give the same dose twice a day. April 20. The increased dose seems to have been of considerable use; has made more progress; he can now walk with the assistance of two sticks; is in great spirits; entertains no doubt of getting well. May 6. Is now so well, that we have advised his father, who lives by the sea, to take him home for the benefit of sea-bathing, which we have no doubt will perfectly restore him.

Extract of a letter (inclosing the preceding Case) from Mr. Kentish.

Newcastle, June 6, 1796.

SIR,

I likewise inclose a letter from my friend Dr. Ramsay, of whose attendance and advice I profited during the whole of the case. I wished his testimony as well as my own, for we are sometimes led to be too partial, where we are anxious for success. This first essay has induced the faculty of the Infirmary here to order an apparatus; and as my partner (Mr. Abbs) is the senior surgeon, I shall have an opportunity of seeing its effects in surgical cases. Several, related both in the 1st, 2d, and 3d Parts of your Considerations, would induce us to hope for considerable aid from it. When I am further acquainted with the result of Captain Hemley's case, I will inform you of it, when I hope to have some more observations to communicate. I shall hope to hear of your receipt of this; and I have the honor to be.

Sir, your obedient humble servant,

J. KENTISH.

Letter from Dr. Ramsay to Dr. Beddoes.

Newcastle-upon-Tyne, June 10, 1796.

SIR,

It gives me pleasure to have an opportunity of adding my testimony to Mr. Kentish's, of the efficacy of oxygen gas, in the case of Captain Hemsly.

I saw the patient after the fruitless administration of the remedies enumerated, and was asked whether he appeared a proper subject for a first trial of Pneumatic Medicine here. Anxious for a trial under less unfavourable circumstances, I hesitated for a while. Hopeless, however, as the patient's situation seemed to be, I at length approved of the attempt, as failure could not lessen my confidence in its general utility; and aware that success in this instance would to others afford proof indubitable of its efficacy.

The case, as drawn up by Mr. K. presents a faithful and accurate statement of facts. The conjunction of cause and effect, that is, the administration of the remedy and amendment, has seldom appeared more distinctly in the employment of any medicine in any disease than in the present instance. The zeal which Mr. K. has uniformly shewn for the advancement of medicine, and his readiness in adopting every means that promise to promote that end, entitle him to the thanks of every friend to science.

I am, Sir,

Your very humble servant,

JOHN RAMSAY.

PARALYSIS. CIRCUMSTANCES.

Case XLIX. Mr. Danby, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 41.

Letter from Mr. Danby to Dr. Beddoes.

Upper John-street, July 19, 1795.

SIR,

I had the honor of receiving your letter, in which you request my case, and an account of the effects that the vital air had on me. I have accordingly drawn up the narrative which I enclose.

I went the latter end of July, 1794, in tolerable health to ———. Not designing to stay there long, I took up my abode at an inn in the town. I ordered, as was my custom at these places, port wine after dinner and supper; I observed the wine had a peculiar sweet and soft flavour, which was very unusual and agreeable, but I by no means drank of it to excess. On the third day after my arrival I was seized with tremors, and

having taken up a pen to write out some music, to my great alarm, I found I could not accomplish it. The friend who was with me, complained at the same time of a most violent bowel complaint, with great griping and copious evacuations. I was soon after seized with spasms, and lost the use of both hands and feet. I proceeded on to Lymington, and having consulted a physician there, was ordered bark and sea bathing. I went then to the Isle of Wight, and attempted to bathe once, and immediately perceived a great increase of my disease. I therefore hastened back to town, and as soon as Dr. Rowley heard that I was in a most deplorable state, he voluntarily came to offer me his services, and with the greatest kindness visited me both in town and country. But notwithstanding those remedies, which I have not the smallest doubt were the most promising of the pharmacopœia, yet my disorder kept on advancing, and as I had been taking drugs for five months without benefit, I grew very anxious to make trial of the vital air, which had been of the greatest service to some of my friends. But I did not choose to enter into any new scheme, without first consulting my friend Dr. Rowley, who, so far from objecting to it, wished me by all means to make trial of the vital air. I waited therefore upon Dr. Thornton. It was the beginning of last December. My hands were pendulous, so that I was obliged to be fed, dressed, and undressed, like a child; being quite helpless, having no use of my limbs, I was also obliged to be carried from place to place; my countenance, as well as I can express it, was of a black yellow; my appetite gone; and my nights truly dreadful. Counting the hours as they passed, I repeatedly prayed for morning, which was no sooner come, than I hurried from my place, as I called it, of torment. You will scarce credit the assertion. A week had not passed from the time of my first inhaling the vital air, before my appetite returned, and my nights were rendered exceedingly comfortable and refreshing; my spirits, as you might expect, were very great; my appetite the same; and my wife and family observed that my countenance was considerably mended. Before the month was out, the motion of my hands was so far restored, that I could compose catches and glees, and in six weeks I began to employ my crutches. My general health is at the present time fully established, I walk about without crutches, and Dr. Rowley says "I ail nothing now but weakness, the consequence of previous indisposition."

I have the honor to be, &c.

JOHN DANBY.

PARALYSIS	CIRCUMSTANCES.
Case L. Mr. Howison, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XVI. page 429.	

Communicated by Dr. Thornton.

Mr. Howison, who dissects for Mr. Cruickshank and Mr. Wilson, eminent teachers in the school of the late Dr. Hunter, had a paralytic affection of the right hand, which deprived him of its motion, and it felt to the other hand always remarkably cold. The paralysis seemed chiefly seated in the muscle of the thumb. I advised him the trial of electricity; and we observed, as well as those who accompanied him, that the electric spark did not fly with a crackling noise to the paralytic muscles. Trying a piece of dead meat, we found the same phenomenon. We then had recourse to inhalation of vital air mixed with atmospheric. The muscle, now receiving oxygenated blood, afterwards caught the electric spark very readily, and a genial warmth was diffused throughout the paralytic hand. This was not a solitary observation, but constantly the case, and it seems to me very forcibly to prove the animating principle derived from the oxygen of the air to the muscular fibre; a principle not, as represented by Mayow, the most subtle, spiritual, and æthereal, but one that can be made obvious to our senses in the form of air, adhering to the calces of metals, and capable now of being conceived even by the most gross understandings.

The patient, I am happy to add, by this combination of external and internal stimulants, is completely restored, and has continued now many months perfectly well.

XX. ATONIA, OR EXTREME NERVOUS AND MUSCULAR DEBILITY.

CIRCUMSTANCES.

Case LI.
Mrs. Roberts, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV, page 65.

Letter from Dr. Thornton to Dr. Beddoes.

Duke street, Grosvenor-square, July 4, 1796.

SIR,

Mrs. Roberts, aged 50, who lives at No. 43, Piccadilly, was more than twelve years ill. She had been successively under the most eminent physicians, first under Dr. Pinkston, then under Dr. Cadogan, next a full year under the celebrated Dr. Cheston of Glocester, from him she passed under the hands of Dr. Farmer, of that city, who attended for two years, and she was next under a distinguished practitioner of Bath, and so she went from one able practitioner to another;

she was at last so reduced, that she was not only confined to her room, but could scarce get from her bed to an easy chair, which was placed in it. Dr. Merryman now attended her. Her long illness had already cost her above 300 pounds. Being called in, I premised a mild aperient, and afterwards ordered bark and lime-water, and gave Mrs. Roberts the vital air. At the time of inhalation this lady felt greatly relieved; the yellowness of her complexion soon wore off; she had a glow of warmth; her appetite and perspiration were established; and so sudden was the amendment, that in less than a month she was restored to perfect health, and has continued so now above three years.

I am, dear Sir, your's, ever,

R. J. THORNTON.

P. S. The quantity of vital air given was six quarts to thirty of atmospheric air.

ATONIA.	CIRCUMSTANCES.
Case LII. Mrs. Robinson, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XI. page 299.	*Letter to Dr. Thornton.*

Dulwich Common.

DEAR SIR,

I return you many thanks for your kind attentions to Mrs. R. Your method of treatment, under Providence, has certainly performed a wonderful cure. My wife had not inhaled the air three times before I perceived a very great alteration, both in regard to appetite and spirits; her strength, in a week, was also so much restored that she could with ease walk five miles, when before it was quite a fatigue to walk one. I can with pleasure likewise add, that what alarmed us both—the coldness of her extremities, and blackness under the finger-nails—are both entirely removed, and her nails now appear healthy. As my wife has not enjoyed such good health for several years as she has experienced these last six months, Mrs. R. unites with me in grateful acknowledgements to you;

And I remain, dear Sir, your's respectfully,

M. ROBINSON.

Observations by Dr. Thornton.

This lady, residing in a country seat, which has a delightful garden, and a good deal of ground attached to it, in an open situation, could not be supposed to want vital air in the blood. Such, however, appeared to be the fact. In such cases I find by the eudiometer, that the blood is in fault, attracting but slowly into its bosom the vital principle. But as even the most apparently incombustible bodies readily deflagrate in pure oxygen air,

as steel, &c. the same phenomenon might be expected in the human frame; and in the present instance we see that this was actually performed. The good, however, of a temporary inhalation of a super-oxygenated air would have been lost, unless the blood had been altered. Steel was therefore enjoined, together with what is styled the phlogistic regimen; and the event exactly corresponded with my expectations—the radical defect was obviated, the attractive power in the blood was improved, and the blood, coming into contact with a super-oxygenated atmosphere, readily imbibed a large proportion of vital air. The blackness under the finger-nails in consequence soon disappeared, the appetite became quickened, the spirits were increased, and the blood freely passing from the centre to the circumference, and from the circumference back again to the heart, the phlogistic particles decomposing the vital air in the blood in its passage, hence the extremities, and the whole body, became permanently warm.

XXI. MELANCHOLIA, OR GREAT DEPRESSION OF SPIRITS.

	CIRCUMSTANCES.
Case LIII. Mr. Russel, cured. Vide Mr. Townsend's Guide to Health, Vol. I. page 292.	Mr. Russel, an engraver, who lives in Constitution Row, Gray's-Inn-lane, had been many years in so desponding a state, that latterly he could not even bear the innocent mirth of his numerous family. He was nearly incapacitated from his employment, and as he had tried bark, steel, and

other tonic medicines, without benefit, he entertained but little expectation of recovery.

He had a cough in the morning, was of a very costive habit, had frequent and violent head-aches, and passed, for the most part, restless nights, or, when he slept, he was troubled with frightful dreams. Being emaciated, and looking very sallow, he was conceived by every one to be in a deep decline.

Dr. Thornton, with that propriety which pervades his whole practice, gave him first an emetic, then a gentle cathartic, and after that, he united all the tonic powers to recover him; as, the inhalation of oxygen air, diluted with a portion of atmospheric air; bark, with a tincture of the same; and columbo root; a more generous diet; exercise; and the amusement of company. He cautioned him, for the easy passage of food (as the motion of the stomach is from left to right) always to lie on his right side.

He gave him occasionally an emetic or cathartic, and, under such judicious treatment, he was in a very short time restored to health.

A letter from Mr. Russel to Dr. Beddoes.

Constitution-Row, Gray's-Inn Road, Aug. 1, 1795.

SIR,

The Rev. Mr. Townsend's account of my case is perfectly correct, and expressive of my situation. Wherever I go, all who know me testify the greatest surprise at seeing me so recovered. Since which time (nearly two years) I have continued in excellent health, having had no return of my former or any other complaint.

I am, Sir,

Your obedient Servant,

JOHN RUSSEL.

Observations on this Case by the Rev. Mr. Townsend.

The symptoms of melancholia are:

1. *Pulse slow, small, weak, and the balance of the sanguiferous system on the side of the veins.* See Cullen's First Lines, § 15[illegible]. This proves that the vital energy of the heart is so much diminished, as not to balance the natural elasticity of the arteries. Hence they contract more forcibly than the heart, and protrude the blood into the veins faster than it can return. The slowness, smallness, and weakness of the pulse seem to be proportioned to the diminution of oxygen. When this fails, pulsation ceases; and the blood being collected wholly in the veins, the arteries are altogether empty.

2. *Respiration slow.* The respiration seems to be governed by the pulse, as I have already had occasion to explain, when stating the consent between the heart and lungs. It certainly bears proportion to the demand for oxygen, as may be observed in dogs, who have consumed more than their usual quantity when in pursuit of game. The more pure the air, the slower is the respiration; but in proportion as the air is vitiated, either by substances, which are destitute of oxygen, or by those which greedily combine with it, the more laborious is the respiration. This may be proved by the breathing of some asthmatic patients, and their cure by well oxygenated air. This we observed in my account of a bilious autumnal fever, to which I must refer the student. Since then the respiration in melancholia is slow, it is evident that the demand in the system is small. If more were demanded, more would be supplied, and respiration would be quickened.

3. *Paleness.* This universally is a symptom of debility, and proves that the balance of the sanguiferous system is on the side of the veins, or, in other words, that the vital energy of the heart is much diminished. This may be clearly proved by the paleness of syncope and death.

4. *Perspiration* and all the *secretions* much diminished. These effects naturally follow the weakened energy of the heart, but they do not altogether depend upon that cause, for the secretions are promoted by oxygen, and suffer loss by its deficiency.

5. *Coldness of the extremities.* That vital heat depends on oxygen, is put beyond a doubt by the experiments of Drs. Crawford, Beddoes, and Thornton, which prove that it bears proportion to the quantity of this received into the lungs. Heat, however, is not generated merely in the lungs, but throughout the system, wherever there is either muscular motion or animal secretion. The pulsation of the arteries, and the oscillatory motion of the extreme vessels, with the secretions, being, as already stated, all diminished, the vital heat must consequently be diminished to the same degree, and this diminution will be therefore most perceptible in the extremities, where the quantity of blood is least and its circulation slowest.

6. *Digestion much impaired.* This effect seems to arise from the diminution of the vital heat, for by the experiments of John Hunter on various animals which sleep through the winter, it appears, that the digestive process is quickened by heat, and checked, or totally suppressed, by cold. But if the student recollects what has been delivered in the first volume of this work, on respiration and digestion, he will be, I trust, inclined to think that digestion is promoted by the inspiration of oxygen, and impeded by vitiated air received into the lungs. Digestion, however, is not produced by either heat or oxygen, but by the gastric juice. We have reason, therefore, to conclude, that for want of oxygen, the gastric juice is either deficient in quantity, as we may be the more inclined to think, when we consider, that all the secretions are diminished, or vitiated in quality, as may be readily conceived, when we reflect, what changes in the whole system are produced by air and heat.

7. *Loss of appetite.* This naturally follows from the deficiency of gastric juice. But when the appetite, instead of being impaired, is exceedingly voracious, this may arise from the stimulus of indigested sordes.

8. *Costiveness.* This likewise may be attributed to want of oxygen, for when Dr. Thornton, as he informs me, made his dyspeptic patients breathe super-oxygenated air, they not only acquired appetite and spirits, but became more regular in their bowels. Oxygen increases the secretions in general, and therefore may increase the quantity of bile, which is the natural cathartic of the body, and, at the same time, giving tone and vigour to the secreting vessels, it is probable that it may improve the quality of the secreted fluid. But independently on this, we may observe, that the perspiration being diminished, the determination is naturally increased to the internal surface, where, at the same time, the glands being much relaxed, a superabundant quantity of mucus, of viscid mucus, is collected, so as to separate between the bile and the animated fibre, and thereby pre-

vent the operation of that natural cathartic. It is not, however, an universal symptom, or constantly present in melancholic patients.

9. *Spirits depressed.* I have already had occasion to speak of well oxygenated air as raising the spirits, and have related the case of Mr. Russel; but since that period we are favoured with many still more interesting cases, in which the same effect is frequently remarked. The case I chiefly refer to is, that of Mr. Atwood, communicated to Dr. Beddoes, and by him presented to the public in the second edition of his inestimable work, entitled, Considerations on the Medical Use and on the Production of Factitious Airs; printed for Johnson, in St. Paul's church-yard. As I very often saw Mr. Atwood during the progress of his cure, I feel highly interested in his journal, where I am happy to observe the same energetic expressions, which I heard him utter, whilst he was under the care of Dr. Thornton. If then the spirits are elated by a plentiful supply of oxygen, are we not warranted in our conclusion, that depression of spirits may be caused by its deficiency? Should we enquire how it happens, that the lungs do not derive a proper supply from atmospheric air, I might simply appeal to facts, leaving others to assign the cause and to account for this effect. But I shall rather make the attempt myself, and at the same time remind the student of the hints, which I ventured to throw out in the first volume of my work.

Every process in nature seems to depend on either attraction or repulsion.

Of attraction, we distinguish various kinds; the attraction of gravitation; magnetic attraction; the attraction of electricity; and chemical attraction. But besides these we observe another, which may be called vital attraction. On this depends the growth of the living fibre.

Vegetables attract their nutriment, both by their leaves and by their roots, which in extent are proportioned to each other. Animals go in search of food; but after they have swallowed and the stomach has digested this, the lacteals make their selection, and absorb such parts as are best suited to nutrition. In them the absorbents of the alimentary canal, at the different periods of their growth, and the pulmonary air vessels bear proportion to each other, and I have already stated a relative proportion between the oxygen attracted by the lungs, and the quantity of food digested by the stomach.

If, therefore, the process of digestion is impeded, the attraction for oxygen and its separation from azot, with which it is combined or blended, according to Jacquin, in atmospheric air, will be diminished. But when the air is overcharged with oxygen, the quantity separated by the lungs in respiration, even in the most unfavourable circumstances, will be encreased.

Thus we see in the burning of a culinary fire, when it is almost extinguished; let the atmospheric air be overcharged with oxygen, or give it nitre, and the effect immediately produced will be rapid combustion with vehement heat and vivid flame; or supposing the air to have only its usual proportion of oxygen, let more combustible matter, such as sulphur, ether, ardent spirits, or even oil, be added to the fuel, and the effect will be the same. In some cases it may be sufficient merely to blow away the dust which separates between the combustibles and oxygens.

These attractions and combinations are governed by the laws of relative affinity, some of which, accurately determined by the sagacious and most laborious Kirwan, he has been so fortunate as to express by numbers.

In accounting for the costiveness, I mentioned my opinion, that it might arise from viscid mucus in the alimentary canal. This cause, as I am inclined to think, will at the same time prevent nutrition, and lessen, in the system, the demand for oxygen, and then we must not wonder that the lamp should emit a feeble light. With a plentiful supply of oxygen and hydrogen, the flame is bright; but a single drop of water floating on the surface of the melted wax, will be sufficient to cut off the communication and prevent their combination, and such appears to me the effect of viscid mucus in the alimentary canal.

From all that has been suggested, I am inclined to think with Dr. Cullen, that in melancholia there is torpor in the motion of the nervous power both with respect to sensation and volition (See his first lines, § 1589); and this, in my opinion, seems to depend on viscid mucus lining the intestines; for no sooner is it, by a judicious treatment, cleared away, than vital heat increases, the pulse acquires strength, torpor is relieved, and the spirits rise.

This perfectly agrees with what I have stated respecting the remote causes of melancholia, all which relax the glands of the intestines, and produce accumulation of their mucus. And upon this principle, Hoffmann in melancholia approves of antimonials, *Quod si enim tenaces, viscidi et biliosi in duodeno stabulantes humores vomitu evocandi sunt; flores antimonii egregium pollicentur fructum.* Vol. III. p. 261.

MELANCHOLIA.	CIRCUMSTANCES.
Case LIV. Mr. Blundel, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XI. page 300.	*Dr. Thornton to the Editor.* SIR, Mr. Blundel, æt. 49, a wholesale linen-draper on Holborn Hill, was subject to melancholia above thirty years; that is, he had frequent depression of spirits, without any assignable cause; and this lowness was not casual, but would remain for months with great languor, and

was accompanied frequently with a distaste of every thing before agreeable. Mr. Blundel's only relief was a journey into the country, which he had been accustomed to take every year. Having two very eminent physicians as half-brothers, the celebrated chemist Dr. Bryan Higgins, and Dr. Haighton physician to the Eastern Dispensary, the most eminent physiologist of this country, every thing that the art of medicine could do had been employed, but without any material advantage. Mr. Blundel wished, therefore, to make trial of the vital air; and he inhaled it at first under the management of a self-taught genius, his neighbour Mr. Varley, of Hatton-House, Hatton-Garden, and found at that time "an increase of strength" and "his spirits mended." But what struck him most was, "an issue which used to discharge was, since his commencing the air, completely dried up." Another thing he remarked, "that after walking he had varicose tumours in the veins of his legs; but that these did not appear, even after a long walk, since he had inhaled the vital air." I will select a few more observations, as made by Mr. Blundel.

"September 20. Spirits much enlivened after taking the vital air.

"September 22. The same good sensations have continued, although I did not take the air yesterday.

"September 23. Found my mind tranquillized, and somewhat elated towards evening; and when I awoke the next morning, perceived a general glow over the body; the feet, which used before to be always cold, were comfortably warm; the fingers glowed to their extremities, and I could clasp them with firmness; before, they would feel cold and numbed, and I was obliged to rub them before I could close them. All my family observe that my countenance looks less sallow.

"September 25. Spirits continued throughout the day very good. Sleep grateful.

"September 26. The same to-day.

"September 27. The same observations to-day."

I should mention, that when Mr. Blundel applied to me, I desired him to continue the air with Mr. Varley, and ordered a seton in the neck, as the issue was dried up. I directed also bark, columbo, and prepared kali, to correct acidity and brace the stomach, as also to render the blood more attractive of oxygen, and the body was kept regular with aloetic pills; and this plan speedily produced the blessing of sound health, which has continued now upwards of fifteen months, without any disagreeable nervous sensations, and without a single excursion being made into the country.

I am, Sir, &c.

J. R. THORNTON.

P. S. In the case of Mr. Russel, which was melancholia, recorded by Dr. Beddoes, the cure was effected without a seton; how much are we therefore to attribute to this application in the

present instance? The drying up of the issue by the vital air, when employed alone, did it not denote, from the absorption of this principle, an increased energy of the absorbents? I have before noticed, that where serum was discharged, that has happened; but when matter is secreted, there is on the contrary a more abundant discharge, or the serum is converted into laudable pus. In the case of Mrs. Fixsen, St. Anne's-Street, Westminster, an issue which could not be made to discharge, began immediately to pour out matter, upon the commencement of the inhalation of the oxygen air. The varicose veins disappearing was a strong mark of increased energy in the circulating vessels. The numbness of the fingers going off, shewed increased action remote from the heart; the glow, the increase of spirits, all declare in marked expressions the influence of vital air; and what makes me the more inclined to this opinion is, that country air before used to afford the only relief.

XXII. SCORBUTIC ERUPTIONS OF THE FACE, ARMS, AND BODY.

CIRCUMSTANCES.

Case LV. Mr. Cummins, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 93.

Letter from Mr. Cummins to Dr. Beddoes.

Islington, August 1, 1795.

SIR,

For more than two years the whole surface of my face was covered over with eruptions. To describe my real state would be as disgusting for you to hear, as it was disagreeable for me to bear. I had tried different purifiers of the blood, but the humour in my face continued the same. Hearing that the vital air altered the state of the blood, about nine months ago I placed myself under Dr. Thornton's care, and began the inhalation of the vital air. In less than ten days I felt a very great itching, which I do not remember to have had before. The itching, however, subsided, and my face was quite cleared in about a month. This state continued four months, when I had a relapse, but it soon gave way to medicine, and my face has continued since perfectly clear, or only here and there a pimple appears.

I am, Sir,

Your obedient servant,

JOHN CUMMINS.

SCORBUTIC, &c.	CIRCUMSTANCES.
Case LVI. Elizabeth Franklin, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. page 138.	*Letter to Dr. Beddoes from Dr. Thornton.*

DEAR SIR,

Elizabeth Franklin, aged 19, naturally of a very strong constitution; with that want of prudence so frequently observed with those who trust too much to this circumstance, after a hard day's labour, being very dry and hot, drank a large quantity of cold water; which immediately produced so violent an head-ache, that she was obliged to go to bed. The next day there appeared an efflorescence on the skin, which soon ended in a scurfy eruption on the arms. It had progressively encreased, it is now five years; and at length incapacitated her from service, and she became a burthen on her family. She had been under Mr. Dundas's care at Richmond eleven months, but without benefit; having before tried a variety of remedies. Observing the great amendment of her neighbour, Richard Major, whose case I have before related, she was induced to apply to me. I ordered her a lotion of nitre and vinegar, which Mr. Patterson, conducted by your observations upon sea-scurvy, found to be a specific in that disease. I gave her vital air to inhale, as a purifier of the blood, in the proportion of six quarts to thirty of atmospheric; and I diffused a greater energy of circulation in the capillary vessels by means of myrrh, bark, and steel, having first cleared the primæ viæ. The effect of the acetum nitrosum, or solution of vinegar in the nitrous acid, was the encreasing the eruption, occasioning acute pain, and rendering the parts very florid. It was, however, persisted in, and, after a fortnight, the benefit from this application became very conspicuous. The vital air, at the time of inhalation, always diffused a glow, encreased the number of the pulse, and produced perspiration. The other remedies tended to keep up this effect; and, after a month, the arms, which before bled upon the least pressure, were in a fit state to bear the flesh brush, which has been ordered; and the surface, after six weeks, only shews the great extent and malignity of the former afflicting disorder; and the young woman is restored as an useful member to the community, being now fit for washing, and any other hard services.

Ever your's,

R. I. THORNTON.

SCORBUTIC, &c.	CIRCUMSTANCES.
Case LVII. Jane Finlayson, under Dr. Thornton. cured. Vide Dr. Beddoes' Considerations, Part V. page 141.	*Letter from Dr. Thornton to Dr. Beddoes.*

Duke-street, Grosvenor-square, Aug. 23, 1796.

DEAR SIR,

Jane Finlayson, aged 7, living at No. 4, Carrier-street, Bloomsbury, had the small pox five years ago; since which period she has been afflicted with a dreadful scorbutic humour, covering both legs, the shoulders, and the arms; which either encrusted, forming scales, or ouzed out a thin, serous discharge, discolouring the linen. She would often awake in the night; when, probably from extreme itching, she would tear the humour, converting it to a sight truly terrific and disgusting. This she would sometimes do, even in the day. Her mother first applied to the Gerrard-street Dispensary; and she took pills and aperient powders for six weeks, under the care of Dr. Jackson, without benefit. Her mother then took her to Mrs. Spilsbury, and she continued taking her drops for nine months; but this boasted remedy was equally ineffectual. She now went into St. George's Hospital, and fell under the care of Mr. Keate; who employed the unguentum hydrargyri nitrati outwardly, with mercurial pills every night, and an aperient powder every third morning; and these were persisted in for three months; but they produced only a slight degree of benefit, and in a few days after she was taken from the Hospital, the disease appeared as bad as ever. Her mother then, from a very prevalent opinion, judged her only hope was from her breathing her native air, and she accordingly took her over to Ireland; but neither the journey, voyage, nor native air, proving of service, she applied to Dr. Frazier, of Dublin, under whose care she continued six months. He employed tar ointment, and a lotion chiefly consisting of a weak lime water: but, as the case seemed to defy all art, the mother thought fit to return with her child, rather worse, than mended, seven months ago. Mr. Ogle, an apothecary in Great Russel-street, at this time refused to do any thing for her, telling her mother, " he could not be of any service, and it was best to leave her disorder to nature." This was the candid opinion of some other gentlemen of the faculty; except that one recommended tar ointment, and it was tried. The disorder however getting a-head, the poor child was for six weeks wholly incapacitated from using the slightest exercise, not being able to stand upon her legs, the humour had spread so around the knees. She was therefore brought to me in arms, and she inhaled immediately six quarts of vital air mixed with twenty of common air; and such is the fact, in two days' time, she was able to walk here, above a mile and a half; her spirits were elated; her complexion was cleared; the wounds had thrown off large scales, shewing a glossy red skin underneath; in a week the progress was such, that some large patches had already disappeared;—in a fortnight the humour on the legs and

thighs was in many places hardened, and had scurfed off;—and in three weeks. on the back and arms there remained only the signs of previous disease;—and it is now twenty days, and the legs, thighs, the back, and arms, shew a truly natural and healthy appearance. The girl took all this time three or four doses of aperients, and no other medicine.

From, dear Sir, your's ever,

R. J. THORNTON.

Letter from Dr. Bubbington to Dr. Thornton.

Basinghall-street, Sept. 16, 1796.

DEAR SIR,

Mrs. Finlayson called upon me yesterday with her little girl, and brought me your letter. My recollection does not enable me, having seen the child but once, to contrast minutely the former appearance of the eruption with the subjacent parts that are now exhibited. I am satisfied, however, that there is a material alteration for the better. The inflammation, I see, has entirely subsided; there is no longer any serous discharge, which, the mother says, was at one time very abundant; and, though there is still a roughness, the superficial scaly incrustation is scarcely now to be perceived. Wishing you equal success in all parts of your professional pursuits, I remain,

Dear Sir,

Very sincerely your's

WM. BABBINGTON.

XXIII. THE TRUE LEPROSY.

CIRCUMSTANCES.

Case LVIII. Amaro Fernandez, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. page 147.

Letter to Dr. Beddoes.

London, October 30, 1796.

SIR,

Don Amaro Fernandez, aged 26, has been afflicted with leprosy above seven years. He is a native of the Canary Islands, where we find that disease prevalent, chiefly among the common people, whose food consists almost entirely in salt fish, ill cured, and eaten in a state of putrid fermentation. This disease resembles much elephantasis, differing perhaps from it only in the extent and urgency of the symptoms. It is generally deemed incurable; and terminates in rendering the unfortunate sufferer a miserable object; depriving him, by its corrosive nature, of nose, ears, palate, and eating away also other parts of the body. It increases by degrees, and sometimes gives a glimmering of hope; but the expectation always proves delusive. I will attempt to trace the dreadful progress of symptoms; and shall commence by observing, that in the year 1789, an eruption broke out on his face, arms, thighs, and legs, which ap-

peared like purple petechiæ, and frequently terminated in offensive sores, discharging an ichorous serum. Mercury and other medicines were employed, but without effect; rather perhaps increasing the disorder. In the year 1792 these symptoms being urgent, Don Fernandez was recommended to try the Bath waters. In the letter which Dr. Scott wrote to the physician of the General Hospital at Bath, he observes, that he had tried bark, elixir of vitriol, hemlock, and that mercury had been rubbed in for three weeks, but without producing any effect on the mouth. He tried there the warm bath; and Dr. Ewart continued the mercury for two months, without its producing the smallest effect; and at length Dr. Ewart, declaring he "had used mercury enough to salivate a horse," advised him to return to London; when he became the patient of Dr. Donavan. It would be tedious to mention all the Doctors under whose care he has been, as Drs. Miers, Relph, Babbington, &c. &c. and many of different countries; and it is impossible to record their several modes of treatment. We shall therefore hasten to the year 1795, and mention the state in which he then was. The sores appear, 1794, to have healed up, by the application of tar ointment; but the muscles at this time were in a very hardened state, and assumed a very black appearance in both extremities. Under the skin there were many hard knots, and in similar points in the corresponding extremities; and these frequently broke into fœtid and deep sores; whilst others dispersed without suppuration; and others again remained stationary. In the year 1795, the nose seems to have been first affected, and the ears, which appeared as if frost bitten, and mortifying off. At this time he was a patient of Dr. Sanderman's, and able to use exercise, notwithstanding the rigidity of the muscles. The disorder went on increasing, and he left Dr. Sanderman; and, in the year 1796, unfortunately fell into the hands of an Italian physician, who, with the most consummate folly, confined him to his bed for six months; ordered a large fire in the room, and no ventilation, and this in the heat of last summer; giving him, at the same time, his grand infallible specific for every disease, which he terms the *Phlogiston of the First Power*. He was at length so debilitated, that he was unable to sit upright in his bed. If he attempted to stand, his legs failed under him; and he had lost his appetite entirely, and hardly had power to speak.

Seeing him in this deplorable state, I mentioned to our Ambassador my wish of his trying the vital air under Dr. Thornton, and his Excellency obligingly complied with my desire. Don Fernandez in consequence inhaled the vital air, was ordered tonics, and such was the amendment, that in a week he was able to be removed from his bed to an airy situation in Chelsea. After his residence at Chelsea, and but three weeks, under this treatment, he was so invigorated, as to be able to walk to and from Duke-street, Grosvenor-square. In six weeks the muscles were evidently softened; there was a less

scaly eruption on the skin; and, at the end of two months, the unsound and sound parts of the nose and ears appeared united; and he is now so strong as to be able to walk from Chelsea to the Exchange, and back, without feeling the smallest fatigue; and his appetite and sleep are the same as if he had never been ill; and he is evidently much increased in bulk. The change produced is so striking, and the trials this patient had made are so numerous, and conducted by so many able physicians, that I cannot but contemplate this, as adding considerably to the reputation already so justly acquired by the pneumatic practice.

I am, dear Sir, &c.

CHARLES DE GIMBERNAT.

XXIV. ULCERS OF THE LEG.

	CIRCUMSTANCES.
Case LIX. The Rev. Mr. Atwood, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 56.	*Letter from Dr. Thornton to Dr. Beddoes.* Duke-street, Grosvenor-square, Feb. 27, 1795. DEAR SIR, I am very happy to hear your proposal for a pneumatic institution meets with the support of so many eminent physicians and men of science. I wait with the utmost impatience for its establishment, firmly be-

lieving that the experience resulting from it will be of the greatest public utility. The subjoined cases will be with you a great inducement for extending pneumatic remedies in the proposed institution to surgery; and they will, I trust, operate somewhat with the public in promoting a subscription sufficient for that benevolent purpose.

The first case will appear to great advantage, as the patient has obligingly permitted me to enclose to you his journal, which is the faithful picture of his own feelings; he assures me, he had not the least knowledge of any part of your theory of the operation of vital air, but was induced, from seeing a somewhat similar cure performed, to confide himself to myself and Mr. Hill, an ingenious surgeon, who has been among the first to apply these new powers to the purposes of his profession.

Journal of the Rev. Mr. Atwood, Rector of Saxlingham and Sharington.

Part I. *Statement of the Case, and of the Effect of the common Means of Cure.*

"December, 1779.—The left [illegible] for some time pas, very heavy; is now much swelled; [illegible] pressure the indentation continues. This was wholly removed in about nine

weeks by means of a very tight bandage on the leg, exercise, spirituous lotions, fumigations, and frictions.—October, 1780. The constitution much impaired by the hot climate of Spain; was attacked with jaundice, which yielded to slow journies on mules, and oranges.—January, 1785. Health was much deranged during this month, with great debility.—1786 and 1787. The habit much relaxed.—December, 1788. Had violent night sweats.—January, 1789. These continued to the latter end of this month.—May, 1789. Had a violent inflammatory fever.—August, 1790. Had an eruption on the surface on the body.—1791. During this whole year, experienced great debility.—March, 1792. Was seized with an inflammatory fever, attended with delirium.—May, 1792. Had a third attack. My physician ordered me sea-bathing, to remove the extreme debility which succeeded to this fever.—From August 1792, to February 1793, bathed in the sea. During this time I had many dreadful spasms in the stomach and bowels, accompanied with nausea and vomiting. These were the forerunners of the disease, which has since affected my left leg.—January, 1793. There appeared a mahogany coloured swelling in the left ancle of the left leg, which kept up an incessant gnawing pain.—July, 1793. This hardness was attempted to be eat away with caustic; but it produced only an ulcer of a very unfavourable aspect.—September, 1793. I placed myself under a most skilful surgeon at Norwich, who applied fomentation, unguents, &c. but without any material benefit.—November, 1793. Though a cripple, was enjoined regular exercise. The ulcer, however, still continued increasing. January, 1794. A new enemy more formidable than the other made its appearance. It had the same dark mahogany colour, and the same unconquerable hardness. By degrees this formed into a dreadful ulcer, which increased daily.—March, 1794.—Came to London, and placed myself under Mr. Cruikshank a surgeon of great eminence. Was attended by him daily with unremitting attention. Twice did he employ the lapis infernalis, but these ulcers seemed to resist every application. My constitution being extremely debilitated, with loss of appetite; want of sound sleep; and the mind exceedingly irritable, sea-bathing was once more enjoined.—From June 14, to October 18, bathed in the sea.—June 27. Mortification took place. The usual methods, bark in great quantities, port wine, and yeast poultices, were had recourse to.—October 25. Returned to London. The pains in the leg were excessive; the fœtor intolerable; the ulcers had made great encroachments; frequent nausea at the stomach; the bark and other medicines were fre- [illegible] sometimes, and now and then the

short, every thing was unfavou[illegible] [illegible]
had seen the whole progress of the case, asked my surgeon, "what prospect there was of saving the limb?" He made no reply, but very gravely shook his head.

The following letter is here introduced as essential to a complete idea of the case.

*To Dr. Thornton.**

Barnet, Feb. 25, 1795.

DEAR SIR,

Being accidentally present at the first interview between you, Mr. Hill, and Mr. Atwood, I cannot help expressing my great astonishment on finding so speedy a cure has been actually effected in so desperate a case.

The wound, I mean what particularly called my attention at the time, appeared to me to extend four inches in longitudinal direction of the muscles of the leg, and about three inches transversely. It was so deep that not only the whole thickness of the adipose membrane was destroyed, but a considerable loss of substance had taken place in the muscular parts themselves.

The ulcer was in appearance as ill-conditioned as I remember to have seen, either in the London hospital, or in my own practice of near thirty years, affording an ichorous fœtid discharge, which appeared to inflame the surrounding parts, and which must therefore have gone on increasing the evil.

The gentleman's habit of body, from his own account, was such (for he had tried bark, sea-bathing, &c. without benefit) that I confess I had not the most distant idea that any cure could have been performed, much less in so short a space of time.

Indeed I think it a great happiness to mankind in general, that such a remedy as the vital air has been discovered, and that men of science are employing it: I am rejoiced to have such proof, that the blood and juices of our fellow-creatures can be so changed, that we need not now despair of our patients even in situations the most deplorable. I have the honor to be, &c. &c.

JOHN CORP.

Part II. *of Mr. Atwood's Journal, beginning the Day before the Inhalation of Vital Air.*

December 13. Got up with a peculiar sensation of weight and pain in the leg; a sense of nausea at the stomach; and no inclination for breakfast; spirits oppressed; and the mind irritable; when endeavouring to walk, felt great pain; the large ulcer in the leg looked of a blackish hue in some places; a probe being thrust into one part of the ulcer, I had not the least sensation in that part; yeast poultices were talked of; had no appetite for dinner; felt very much indisposed towards the evening; no inclination for supper; had a sense of chilliness on first getting into bed, succeeded by hot pains; passed as usual a bad night, with perturbed sleep; awoke at two o'clock with sharp and burning pains in the leg, which continued until five in the morn-

ing; dosed till nine.—December 14. Got up with nausea at the stomach; and a sense of languor; no appetite for breakfast; spirits exceedingly oppressed; for the first time inhaled the vital air diluted with a portion of atmospheric; had a pleasurable glow at the time; felt an appetite for dinner, and my friends observed my cheeks did not flush after dinner, as heretofore; my spirits, which were somewhat better during the day, sunk towards the evening; no inclination for supper; passed a very indifferent night.—December 15. Got up, but without a sense of nausea; had a slight inclination for breakfast; perfect ease in the leg; inhaled again the vital air; felt a great appetite for dinner, and a peculiar pleasurable lightness after dinner, as if no sustenance had been thrown in; with a flow of spirits; and a strange idea of being able to mount a horse, and ride as fast as people in health; appetite for supper; passed the sweetest night! such as I am sure I have not enjoyed these four years.—December 16. Got up quite refreshed, without the least sense of nausea at the stomach; a great inclination for breakfast; spirits unusually elated; took the vital air; felt a genial glow during the whole day; great appetite for dinner; walked with agility and without pain; the wound however appeared unfavourable to-day; appetite for supper; a good night; awoke with a thick clammy perspiration.—December 17. Spirits much depressed; no inclination for breakfast; mind very irritable; much pain in the wound; inhaled the vital air; the wound threw off nine sloughs this day; a slight appetite for dinner; the spirits recovered towards the evening; inclination for supper; had a sound night's rest.—December 18. Appetite for breakfast! inhaled the vital air; a sense of glow, which extended even to the fingers' ends; the muscular powers were evidently increased; walked with slight, or no pain.—December 19. The wound for the first time discharged real pus; had the sensation, if the expression can be allowed, of perfect health, never experienced before this week; sleep very sound; pains in the leg towards morning.—Dec. 20. Got up with great spirits; inhaled the vital air; the wound discharged a great quantity of real pus; a craving for dinner; felt no longer an inclination for much wine, and after four glasses, had the same satisfaction, as three pints used formerly to produce; porter was now rather coveted; spirits elevated in an extraordinary degree, which, together with a genial summer's warmth, continued from four to nine in the evening, and then subsided to humble spirits; slept profoundly from ten to four, which, with the morning doze, made me get up sufficiently refreshed; transitory pains in the leg.—December 21. A fine appearance of white edges in the wounds; great appetite for dinner; an universal glow in bed, accompanied with perspiration; sharp twitching in the leg.—December 22. Appetite for breakfast; inhaled the vital air; the wound still kept on a great discharge of laudable pus; no appetite for dinner; in the evening a peculiar sense of weight and uneasiness

in the leg; a great listlessness in the evening; much irritation in the leg, particularly in the ulcer, with much itching round the part; but an indifferent night.—December 23. Spirits oppressed; inhaled the vital air; returned home without much inclination for dinner; spirits rather mended towards evening; enjoyed a good night's rest.—December 24. Eat a hearty breakfast; spirits elevated; walked with ease and vigour; a surprising change for the better had evidently taken place in the wound; appetite for dinner; had a good night.—Christmas day. Still the same happy appearance in the wound to-day.—December 27. The ulcer looked wonderfully well; was evidently decreased in size; the discharge very favourable; but less in quantity; great pain was felt in the ulcer for a quarter of an hour in bed; afterwards fell into a refreshing sleep.—December 28. All the appearance of healing; the wound much decreased; some parts filled up; and the borders of a fine white; the whole leg, which before exhibited a dark purplish appearance, wore now the livery of health.—December 29. The cavity of the wound was almost filled up; the effects of the vital air operating together with my amendment, produced a constant gaiety, as if I had been drinking champaign; enjoyed a profound night's rest.—December 30 and 31. The same sensation of perfect health; elevated spirits; great appetite; and comfortable sleep.—New-year's day. Every thing in a good train. My toast after dinner was, "May Dr. Beddoes and Dr. Thornton the introducers of aerial remedies meet with that recompence from their country, which they so amply deserve."

[This toast from motives of delicacy I would have omitted, but I thought it my duty to transmit you the journal entire as written by the author. R. J. T.]

"It was applauded and unanimously drank.—Jan. 1, 2, 3, 4, 5, 6, 7. As on the preceding days, with evident and progressive amendment in the wound.—January 8. Went to a private concert; before, music was disgusting to me, having no spirits to enjoy it; was surprized to find myself standing, as I was playing on my violin, without leaning on a chair, at several different times during the evening, and without the least sensation of fatigue or pain.—January 9. The smaller ulcer, which of late I have not much noticed, was healed.—January 10, 11, 12. Nothing peculiar.—January 13. The old ulcer was this day rubbed hard with a flannel, and the larger ulcer appeared nearly healed.—January 14. Walked with great vigour; the larger ulcer was rapidly skinning over; appetite good; spirits good; and sleep the same.—January 17. Notwithstanding the season, the most inclement I remember, the ulcer was completely skinned over; and my body seemed fortified against cold."

Here ends the journal. I have to add that on the 25th of February, the family received a letter from Mr. Atwood, from on board the Stately, of which ship he was made chaplain. He was then in perfect health and spirits.

Letter

Letter from Mr. Atwood to Dr. Thornton.

Symon's Town, Cape of Good Hope, 15th Sept. 1795.

MY DEAR SIR,

I ardently wish to enjoy the happiness of seeing you again. You have performed wonders on my peculiar constitution, formerly strong and powerful, but which was hastening to a rapid dissolution, till revived and renovated by the oxygen air. My strength is encreasing every day with a firmness of nerve and calmness of spirits never experienced before. I persevere in an uniform plan of rising at six, walking till eight, subsisting on soup, fish, and vegetables, and going to bed at ten. Wine is left off (except three glasses of white Teneriffe wine at dinner), as well as meat. By these means I feel the habit cool and braced, with a capability of taking powerful exercise, without the least fatigue. The fleecy hosiery waistcoats you recommended are absolutely necessary in this climate, as heavy dews and cold winds at sun-set often succeed the heat of the day. The prevailing disorders of course are fevers, flux, and dysentery, which destroy many patients; except this sudden check to perspiration, the climate is delicious, but in my opinion not so hot as at Lisbon. Last June (December here), green peas were in blossom.

With the greatest esteem,
I remain, ever gratefully yours,
T. E. ATWOOD.

ULCER OF THE LEG. — CIRCUMSTANCES.

Case LX.
John Patterson, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 65.

Communicated by Dr. Thornton.

John Patterson, aged 45, married, has five children; he was formerly a sailor. He had endured much hardship, and at one time lived for nine months wholly on salt provisions. He was subject from the age of fourteen to eruptions on his face. When he came under Mr. Hill's care, I saw him, with a face encrusted over with humours, several purple blotches on his body, many hard scales or scurffs about his arms, and a dark-coloured deep ulcer in his leg, which gave out an ichorous and fœtid discharge. He had also lost his sight near eighteen months. These complicated evils had resisted the well-known abilities of Messrs. West, Carr, Turnbull, Wathen, Phipps, and others. This case being recommended to Mr. Hill by the last named gentleman, he gave him the vital air blended with atmospheric air, as an alterative of the blood, strengthening his constitution with chamomile tea and bark, and Mr. Phipps continued those applications to the eyes, which, before the purification of the blood,

proved unsuccessful. After a few weeks' inhalation of the modified atmosphere, I had the satisfaction of seeing him with a face perfectly clear and smooth; large white scales fell from his hands and arms; the dark purple ulcers on his body, and the varicose ulcers in his leg, were healed; and he had so far recovered his sight, that he had at first a blue, then a brighter light before him, and after a regular attendance during four months, he was able to discriminate different objects in the street.

Letter from the Rev. Mr. Townsend to Dr. Beddoes, relative to the two last Cases.

Pewsey, July 21, 1795

DEAR SIR,

When I was in town, Dec. 15, I called on Dr. Thornton, and finding him engaged with patients, I went into the parlour, where I met with Mr. Atwood. We soon entered into conversation, when he communicated his apprehensions of losing his leg, and asked me if I believed that the vital air could effect any thing in such a case. Finding this gentleman desirous of having my opinion, I explained to him, that though spirituous and other stimulating local applications might call forth, for a time, the action of a part, in which the vital energy was much diminished; yet, as exhausting it without producing action sufficient for a cure, a proportionable debility and tendency to gangrene must ensue. This, Sir, said he, is exactly my case. After every application, exciting pain, black parts have constantly appeared, which were either taken away by the knife, or else sloughed off. It is so, said I, with spontaneous mortification: it is preceded, in weak habits, by inflammation accompanied by a proportionate loss of power. But when the air is rendered by the chemist more replete with that substance, which is essential to vitality, and is inhaled by the lungs, this alters the disposition of the system, and produces what has been called the phlogistic diathesis, whereby the exhalant arteries pour forth instead of serum, coagulable lymph: the absorbents carry away diseased parts; and the lymph being rendered more tenacious, is converted into granulations. In the new mode of treatment with vital air, energetic action in the part is supported by the system: in the old practice it is kept up for a short time only, by partial stimuli on weak and diseased vessels. There it is produced with a change of the blood; here it deprives the blood of life: there it produces energy; here it excites irritation: there it aids the efforts of nature, and renders them effectual; here it calls her into action, which she is unable to support. This reasoning seemed to have weight with him, and now our conversation was interrupted by a message from Mr. Hill, that he was ready to attend his patient. However, I begged permission of Mr. Atwood to see his wounds, which emitted a very offensive fœtor,

and had discoloured his stocking. But no sooner were the applications taken off, than the fœtor became intolerable, and the sight so disgusting, that I was constrained to hasten into the open air. On my return to London, Jan. 15, I was impatient to know what had been the issue, and gave Mr. Atwood the meeting as before. The lesser of the wounds was healed, and bore the friction of a brush. The larger wound, so well described by Mr. Corp, (Second Edition of Considerations, Part II. page 55) was filled and covered with skin, excepting one place the size of my nail, which he told me was occasioned by some accident.

I was equally pleased this day with having a sight of Patterson, whose case is so well described by Dr. Thornton (Consid. Part II. page 57). His leg, now healed, shewed what had been the extent of his former ulcers which were not fewer than fourteen or fifteen; his face was clear, and when I put a little bit of paper on the ground, he saw well enough to go and pick it up.

I am, Sir, &c.

JOS. TOWNSEND.

ULCER OF THE LEG. CIRCUMSTANCES.

Case LXI.
Mrs. Munt, under Dr. Thornton and Mr. Hill, cured.
Vide Dr. Beddoes' Considerations, Part I. page 66.

Communicated by Dr. Thornton.

The subject of the next case is a widow lady. She had a humour in her right leg, which deprived her of exercise, and had produced a painful and discoloured sore in that part of above 18 years' standing; four years of which time she was attended by Pott, and twenty-seven months by Sharp; but neither of these eminent surgeons were able to effect a cure. After only three weeks' inhalation of the vital air, a violent itching came on, and in another week this leg was rendered as sound as the other. Mr. Sharp saw this patient at Mr. Hill's, and examined her leg, and was very much delighted. This lady has now continued well near six months.

Letter from Mrs. Munt to Dr. Beddoes.

Store-street, Sept. 1, 1795.

SIR,

I was about eighteen years distressed with a dreadful humour covering the whole of the lower part of the left leg. It arose from water first in that part, and a tendency to the dropsy. I was four years under Surgeon Pott, twenty-seven months under Sharp, nine months under Blick, twenty-seven months under Wade, and for some time under other eminent surgeons, but the humour continued as before. Previous to my attendance on Dr. Thornton and Mr. Hill, I was very bad indeed, in great pain

and not able to walk fifty yards. After a fortnight from inhaling the vital air, I felt a most intolerable itching in the leg, and soon after the humour scurfed away, and the leg was healed. It is now eleven months since my cure, and I have felt no pain whatever, nor has even a pimple appeared on the part; and as before I could not walk an hundred yards, now nothing impedes my walking but my corpulency, which probably arose from my former long confinement.

I am, Sir, &c.

ELIZ. MUNT.

Observations on this Case by Dr. Thornton.

1. In fat people I have observed that super-oxygenated air usually creates some disturbance in the stomach. This at first surprised me; but did not the super-oxygenated blood feed upon the elements of fat, and thereby prevent the supply of food from the stomach, and that organ being robbed in some measure of its office, might it not at first feel the want of its customary action?

2. Fat people, I observe, are longer in consuming a given portion of air than others; hence perhaps they become liable to diseases, dependent on, or accompanied with, a want of oxygen in the blood.

3. In the present case strong occasional evacuations were employed. In the intervals, bark with the tincture of the same, and myrrh, were given to strengthen the fibres and promote the consent which exists betwixt the stomach and the lungs.

4. The average dose of air employed, was thirty quarts of atmospheric air, super-oxygenated with two and sometimes three quarts of vital air.

ULCER OF THE LEG.	CIRCUMSTANCES.
Case LXII. Mrs. Wilkinson, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 139.	*Communicated by Dr. Thornton.* Mrs. Wilkinson, who lives in Dartmouth-street, Westminster, had for fourteen years a scorbutic humour in the legs, corroding into sores the muscular parts, which scurfed, and occasioned frequent and violent pain, and an almost incapacity for exercise. The muscles of the calf were hard, and of the

colour of mahogany. A great variety of remedies had been tried, as water-dock, elm bark, sulphur, &c. and this lady, by the advice of Dr. Haighton, physician to the Eastern Dispensary, had taken for the last four months bark and lime water. As Dr. Haighton thought her disease depended wholly upon the

constitution, and there was no need of any local application different from what Mrs. Wilkinson was in the daily habit of applying, I was happy to add upon this occasion the vital air. This lady, after inhaling a week, felt violent itching and pain in the legs; the colour of the parts was visibly improved; and the ulcers exhibited marks of active inflammation. In a few days after this, the wounds, which were ten in number, instead of a thin acrid discharge, threw out pus, and the edges were diminished. The hardened muscles not long after became soft. The other beneficial effects of the vital air, as far as regards appetite, spirits, warmth, sleep, &c. were the same as those which are so energetically described by the Rev. Mr. Atwood, in his invaluable Journal. In six weeks only Mrs. Wilkinson could use the flesh brush to both legs; and the last account I have of this lady is, that she was able to walk from Ramsgate to Margate, five miles, without a sense of pain in the legs, or even fatigue. I shall hope to send, at some future time, the sequel of this interesting case; and shall beg leave now to observe, that the leg of Patterson, which had for two years fifteen or twenty holes in it, which were healed by the inhalation of a super-oxygenated air, has continued perfectly sound, it is now above eighteen months; which leads me to the hope, that a permanent benefit will be also derived to this lady.

R. J. THORNTON.

Letter from Mr. Wilkinson to Dr. Thornton.

Darthmouth-street, Sept. 7, 1797.

DEAR SIR,

Although you have never once asked my opinion respecting the effect your air has had on my wife, I think it but justice publicly to declare, that during the course of fourteen years my wife has never enjoyed such a state of health as since she has inhaled the factitious air. She has in that course of time applied to several medical men of great ability, but without any good effect. She had not inhaled the air more than three times, before I perceived a very visible difference in her countenance, in her spirits, in her appetite. The ulcers in her leg gradually dried up, and have never appeared since; it is now a twelvemonth. She is now ten years younger, at least, in constitution. In short, whatever Prejudice may say, I am sure, that under God, the oxygen air has been the sole means of her recovery; and that there is not any one thing in nature besides that the cure can possibly be attributed to. I most sincerely thank you, Sir, for your kind attention to her, and I do sincerely believe if mankind at large were as sensible of the good effects of the air as I am, when properly and judiciously administered, you would need a host of agents to assist you in this grand and benevolent undertaking.

I am, dear Sir,

Wishing you every success your merits deserve,

Very sincerely your's,

J. WILKINSON.

ULCER OF THE LEG.

Case LXIII. Mr. M'Kennon, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XIX. page 291.

CIRCUMSTANCES.

Communicated by Dr. Thornton.

Mr. Roderick M'Kennon, aged 67, went in the year 1758 as Assistant Apothecary to St. George's Hospital, where he had his washing, board and lodging found him, with a suitable salary. In June, 1795, whilst in this employ, he went to see Dr. M'Nab, then resided in Great Suffolk-street; and as he was at the door, a bitch in the house, who had puppies, furiously flew at him, and seized him near the calf of the leg, making a deep lacerated wound. The wound soon after became dreadfully inflamed, poultices were applied, but it was near a fortnight before he made his case known to the surgeons of the hospital. He was now confined to his room, and Mr Home a most experienced and eminent practitioner continued his humane attentions to him above a twelvemonth, trying a variety of different applications, until, finding his case baffle all his endeavours, he was dismissed his employ, and left the hospital as incurable. Added to this dreadful and unforeseen affliction, he had an asthma, which had existed on him above ten years, which obliged him frequently to sit up the greatest part of the night with the windows wide open to procure breath. He was now in the vale of years, and with a gloomy prospect before him, for no salary was allowed this almost superannuated servant of a public charity, to which he had been attached above thirty years; and he had a wife and daughter to provide for. After quitting the hospital, Mr. Carpue, surgeon, no less distinguished for zeal than abilities, for [illegible] mouths attended him; but finding all his endeavours ineffectual, he reluctantly took his leave of him as incurable. Such was the deplorable state of this unfortunate sufferer, when Mr. Carpue recommended him for trial with the oxygen air, using these very expressions: "Poor Roderick has been under Mr. Home's care" (an eminent surgeon, brother-in-law to John Hunter), "in St. George's Hospital, which he left as incurable, and since under my care for several months; and so bad is his case, that I am sure if you can cure him, you can cure the devil." Being no surgeon, I could have no wish to accept of such a case but for the cause of humanity and the sake of science; and I feel extreme delight in saying, that poor Roderick is now perfectly cured, the ulcer is healed, his asthma gone; and, in order that the philosophic world may see fuller particulars respecting this extraordinary cure, I am happy to be able to add the following testimonies:

A letter to Dr. Thornton from Mr. Carpue, Surgeon at the York-Hospital.

DEAR SIR,

I have seen Mr. M'Kennon, and have examined his leg, and think the cure you have wrought on it is indeed very astonishing. When he first came under my care, he laboured under an immense ulceration, extending from the external ancle of the right leg, which reached as high as the junction of the tendons of the gastrocnemii and solæus muscles. At this period the tendons of the peronæal muscles had sluffed, and in consequence I applied charcoal, which produced very considerable good; but upon mentioning this to a friend, who knew the case well*, he said, "It was immaterial what remedy I used, for it was a case in which he was certain nothing would prove effectual." After [illegible] I applied the diluted nitrous acid, and seemingly with advantage; but being obliged to go into the country, I left him under the care of another surgeon; and when I saw him, after [illegible] absence of six weeks, I found the sore in a very unfavourable [illegible], a[illegible] four months I used different applications, but [illegible] and I conceived the case now to be perfectly in[illegible] and [illegible] mentioned it to you when I had the pleasure [illegible]eting you at Mr. Heaviside's [illegible] and I then proposed him to [illegible] the trial of the oxygen air, as his case, [illegible] successful, [illegible] prove most decidedly its efficacy; for, in the multitude of legs I [illegible] attended, I must acknowledge I never saw a [illegible] case old West-India sores excepted.

I have the honor to be, Sir,

[illegible]ur obedient servant,

J. C. CARPUE

Having referred Mr. M'Kennon to Mr. Spencer, a surgeon in Charlotte-street, Fitzroy-square, who administers the pneumatic remedies, I received the following letter:

A letter to Dr. Thornton from Mr. Spencer.

SIR,

I herewith enclose the treatment and the progressive cure of the ulcer which occupied the external ancle of the right leg of Mr. M'Kennon. For six weeks, by your direction, he daily took a gallon of oxygen air, mixed with four times that quantity of atmospheric air. The ulcer discharged properly, but seemed to heal very slowly: in consequence I gave him a double dose, and after a fortnight it produced very feverish symptoms, when he took, by your order, some purgatives, and then he resumed his usual dose of superoxygenated air daily, until the ulcer di-

* Dr. Bailey, physician to St. George's Hospital.

minishing by degrees, was at last completely healed, there being no discharge, the whole cicatrising, and the new-formed surface looking extremely healthy. During this period no particular application or dressings were made use of by me, nor any medicine directed by you, but what before he said he had taken gallons of; so that I attribute his extraordinary cure entirely to the efficacy of the oxygen air. Happy in being able to give my testimony to so remarkable a case, I have the honor to be, dear Sir,

With the profoundest respect,

Your obedient humble servant,

T. SPENCER.

Remarks by Dr. Thornton.

As Mr. M'Kennon took bark, some of the faculty may not be willing to give to the oxygen air the merit in this cure; I will therefore endeavour to state shortly my reasons for attributing every thing to this new remedy.

1. The operation of bark had been before tried; he had taken, he said, gallons of it.

2. When I first saw him, the sore, and muscles surrounding it, were wholly insensible; he did not feel a needle piercing them, nor could he perceive even the corrosive operation of caustic.

3. After inhaling the vital air but a few days, sensibility was restored, as Mr. Carpue and others witnessed.

4. Having cleansed the wound, it would remain dry for hours; but even whilst inhaling the vital air, the whole surface was immediately covered with a fine dew, as Dr. Monro and others witnessed.

5. To shew the progress of amendment whilst inhaling the superoxygenated air, I am happy to be able to lay before the philosophic world the following testimony of an impartial observer, Mr. Douglas, of Baliol-College, Oxford:

"Towards the middle of March, 1798, I first saw Mr. M'Kennon. He had then a large and very foul ulcer, extending some inches above the right ancle. From that time to the present (April 30) I have repeatedly seen him, and each time could not possibly fail to be sensible of a most manifest improvement. At present the ulcer is diminished at least one-half in size since I first saw him; the edges have a fine healthy appearance, and its general surface is astonishingly altered for the better."

6. When the oxygen air was left off, the sore remained stationary, and visibly improved when he again resumed it.

7. My strongest argument, however, is the success in this and in other cases equally desperate.

Mrs. Munt had been before cured of a sore leg of eighteen years' standing.

Mr. Atwood was cured of a sore leg of two years. When I asked Mr. Cruikshank whether it was true he had condemned the leg? he answered, with his usual emphasis, "I not only condemned his leg, but his life; for he was of so washy a constitution that he could not have lost the one without the other."

Next, the cure of Patterson. When I sent him to shew his leg to Mr. Cruikshank, which still possesses the marks of numerous ulcers, seeing varicose veins, this experienced surgeon said: "Tell Dr. Thornton that he is mistaken if he supposes he has made a permanent cure; for varicose ulcers were never cured without an operation, which, if he wishes, I will perform." The man, frightened at first, and then astonished, replied: "Sir, I have been cured perfectly now these two years." "That altèrs the case," answers this distinguished anatomist; "then tell Dr. Thornton that he has performed a most remarkable cure." Patterson still continues well; nor does there seem the smallest cause to suspect a relapse.

The cure of Mrs. Wilkinson, who had a sore leg fourteen years, is not less extraordinary. In this case I observed a peculiar phenomenon, alone explicable by the operation of the oxygen air. The fingers of both hands at their ends looked very red, as red as raw meat, were swollen, and felt very painful. The same was mentioned to me in private conversation by Dr. Beddoes in a patient of his, who, finding an asthma relieved by a small dose of vital air, took as much as he could at one time, produced a fever, and this same phenomenon I have just mentioned above.

This leads me to repeat an observation I have again to express, that oxygen air promises to be an useful remedy in sore legs; for why have we not sore arms? The nearness of this part to the heart seems to be the only philosophic reason; and therefore a direct powerful stimulus to the heart, as oxygen air, promises the most certain good, aided by the invigorating effects of bark, steel, and other tonic medicines*; not but that I would advise, where it can be properly done, as in hospitals, trials to be made with the vital air without medicine, to prevent all cavil; although it is undoubtedly unimportant to the sufferer by what means he is treated, so that he is but cured; and, until the contrary is proved, I shall ever think, that medicines, judiciously employed, certainly cannot impede the operation of oxygen, but may assist it.

* Vide general observations at page 543, and note * page 545, of this volume.

XXV. MORTIFICATION OF THE HEEL.

	CIRCUMSTANCES.
Case LXIV. Mrs. Frith, under Dr. Thornton, cured. Vide Philosophical Magazine, No. X. page 213.	*Communicated by Dr. Thornton.* Mrs. Frith, æt. 45, wife of the Rev. William Frith, rector of Kentish Town, for nearly four years experienced the most violent pain in the neighbourhood of the heel, which she could compare to nothing but the burning of a caustic. Various outward

applications had been made, and medicines taken internally, without any alleviation. When Mr. Cruikshank, lecturer on anatomy in the school of Dr. Hunter, called me into consultation, there was extended over the heel a wound about the size of a crown, very dark, the edges livid; and the fœtor from it was so intolerable that, when her maid had occasion to remove the dressings, she had always volatiles applied to the nostrils to prevent her from fainting. The countenance shewed a livid paleness, the pulse was quick and tremulous, and the slightest exertion produced faintings. The bark, opium, and wine, were continued. This lady inhaled also six quarts of vital air mixed with twelve of atmospheric, and in a few days, as this respectable family can also testify, the livid hue of the wound disappeared, it had a more healthy appearance, and the discharge was so greatly improved, and fœtor gone, that when the smelling-bottle was presented to the servant, she said that there was not the least occasion for it. In a fortnight the sore was completely healed, the appetite restored, and countenance so greatly improved, that every friend marked the sudden alteration; the violence of the internal pain lessened by degrees, and the superoxygenated air being continued for a few weeks longer, it altogether subsided; and this lady, for these last six months, has enjoyed uninterrupted health, and is able, at pleasure, to walk up Highgate-hill.

As many persons might wish to see the lady's journal in her own words, I here subjoin it, with a few observations.

"September 13, 1798. First inhaled the vital air. Felt acute spasms in the chest, and fainted."

Observation. Artificial inhalation is accompanied with increased action of the intercostal muscles, and gives frequently afterwards a sensation of muscular pain, which speedily goes off, and after a few trials does not appear again. The second effect we always see in those very weak, and hence the expression of "*being overpowered by the air.*" Patients labouring under scurvy, if suddenly exposed to a clear air, are killed instantaneously.

"September 15. Felt a most pleasant glow after the inhalation of the vital air. Spirits also much increased, feeling as if a great weight, or oppression, was removed.

"September 16. The hardness about the heel gone, as also the fœtor. Has less discharge. The wound looks redder. The glow, after the inhalation of the vital air, lasts for about a quarter of an hour.

"September 18. The glow, and spirits, after the last inhalation, lasted four hours. Feel wonderfully light and pleasant.

"September 20. Asked by my apothecary, "Whether I did not feel, from the inhalation of the vital air, an uncomfortable heat?" My answer was, "that it produced the most pleasant glow imaginable, not at all resembling heat."

Observation. Putting the thermometer under my tongue, the heat was not increased. This effect may, perhaps, be accounted for from the increased sensibility of the nerves; or does the insensible perspiration raised by the capillaries of the skin being filled by the greater energy of the heart, account for this phenomenon better? I have almost invariably found the inside of the palm of the hand, after and during the inhalation, break out in a pleasant moisture, which are parts somewhat remote from the heart.

"October 4. The pain in the heel infinitely more lively. The pain is a new pain; but, thanks be to God! it remits for three or four hours every day."

These are the chief particulars: the plan of your Magazine may not admit of a further detail, nor does the nature of the case seem to require it.

General observation. The change of colour in the wound, so immediately after the inhalation of the vital air, seems to indicate a remarkable change wrought in the blood. It is not, however, the temporary increase of oxygen only in the system, that this partial inhalation produces; for it renders the blood also more attractive of this principle. Hence the continuance, for some time, even in London, among people of fashion, of the good looks acquired in the country; hence the pallid countenance of the man lately recovered from suffocation, or drowning; and hence, also, the return of the breath in patients under this treatment being more and more noxious, from a greater absorption of oxygen. The deterioration of the air inspired, has ever indicated the attractive power of the blood. Hence, also, it is that substances abounding in hydrogen are called cordials, from their sympathetic action on the heart, through the medium of the blood: but in the superoxygenated air we have a more direct action on the heart, without exhausting the irritable principle, and occasioning indirect debility; and I trust I shall be able to make it evident to the unprejudiced mind, that this is a great desideratum in surgery and medicine, more especially where diseases are remote from the heart; or else, why do we so frequently hear of sore legs, but never of sore arms?

XXVI. ATONIC GOUT.

	CIRCUMSTANCES
Case LXV. Augustus Ernest, under Dr Thornton, cured. Vide Number XXI. of the Philosophical Magazine.	*Communicated by Dr. Loane.* Augustus Ernest, Esq. in the beginning of August, 1799, was seized with symptoms of asthma, great wheezing, and difficulty of breathing, cough, mucous expectoration, and incapacity of lying in an horizontal posture. Hence arose much œdema of the lower extremities. Different

medicines were tried without effect, when Lord Egremont urged him to make trial of the oxygen air under Dr. Thornton, September 20. This remedy was accordingly had recourse to, and after inhaling the vital air but a few days, so much benefit was derived, that the patient was enabled to lie composed in bed during the whole of the night, and after a fortnight so great was the energy produced, that the gout made its appearance in the great toe of the left leg. The asthma, from this period, quitted Mr. Ernest, and the inflammation continued for the space of ten days in the toe and parts adjacent, and the subsequent swelling gradually subsiding, the patient was restored to perfect health. He then went to Lord Egremont's, previous to which I received the following satisfactory letter.

Letter to Dr. Loane.

November 9, 1799.
Warwick street, Golden-square, No [illegible].

DEAR SIR,

I am just going into Sussex to breathe there some of [illegible] atmospherical air; but I cannot leave this metropo[illegible] reiterating to you and Dr. Thornton, with the tende[illegible]gs of gratitude, the warmest acknowledgments for the [illegible] benefit you have conferred on me, by administering to [illegible] vital air; indeed, when I compare the situation in whi[illegible] was, at the end of September, when I, as a dying man, came under both your cares, to what, thank God, you have brought me now; it seems to me quite miraculous, and I shall always look with astonishment at the wonderful discovery which has been made of the salutary virtues of the oxygen air.

I am, with sincere regard,

Ever faithfully your's,

AUGUSTUS ERNEST.

When Mr. Ernest returned to London, his friends, Lord [illegible]sey, Count Bruhl, &c. congratulated him on his recovery, but his

asthma soon after made him a second visit, and the vital air was again resumed, when in a few days it brought about another attack of gout in both feet, which went off kindly, leaving the patient in excellent health and extraordinary spirits.

It may be proper to mention the average dose of vital air daily given was six quarts, mixed with twelve of atmospheric air, and this was conjoined with the medicines most commonly given in such cases.

Several other interesting cases will be found in the body of our Work, in which *vital air* was administered, chiefly with the intent of counteracting the evil of vegetable and animal poisons, and we trust enough has been already done to invite other labourers into the vineyard; and happy shall we think ourselves if our endeavours have at all conduced to that end.

As the Reader advances in this Work, he will see the system upon which the conduct of the *pneumatic* practitioner was conducted, and perhaps may be induced with him to think, that multiplying the tonic actions in asthenic diseases by as great variety of means as possible*, is the most philosophical mode of practice; and the facts adduced are a sufficient evidence of its utility.

We come now to the consideration of the application of *azotic air*, which has been given to moderate the too great action of the system, or take off local inflammation.

* Vide especially Vol. II. Note * page 502, where [illegible]inciple is enforced, and it explains how the *aerial remedy* becomes a[illegible]e in *such a number of diseases*. In the practice represented here, the stomach is braced and strengthened by bark, myrrh, steel, and zinc; the blood im[illegible], and hence the whole vascular system, by the inhalation of [illegible] mind is likewise exalted with the hopes and novelty [illegible]s mode of living enforced; and thus every energy [illegible]e is called forth. But the public mind has been long [illegible] the doctrines of *specifics*, and as, "what is good for every [illegible]d for nothing," for QUACKERY advertizes the same *specifics* for ev[illegible]sease, so no credit will be given by many to the healing powers o[illegible]he constitution, and less to those means which act *on the Constitution*, and thus *on a variety of diseases of the same class*, but in the issue, "*truth and science will prevail*:" and as constitutions are differently affected by the same means, hence the necessity of *discrimination* in the practitioner, and hence our prophecy, that the extinction of *Quackery* is at no great distance in an enlightened age. Steering is very simple, move the rudder ever so little to the right or left, and the ship turns in a contrary direction, put it straight, and the ship moves straight, but GOD has so connected mankind, that even the conduct of this simple process requires some intelligence, and it will be found to be the same with engraving, writing, tuning of instruments, hair-dressing, and *physic*.

CASES WHERE AZOTIC AIR HAS BEEN EMPLOYED.

XXVII THE CROUP.

	CIRCUMSTANCES
Case LXVI. Mary Tovey, under Dr. Thornton, cured. Vide Mr. Townsend's Guide, Vol I. page 103.	Mrs Tovey, of Charles-street, Tottenham-court Road, having lost one child in this sonorous and terrific disorder, anxiously brought her only remaining boy to Dr. Thornton for his advice He immediately made the child inhale the azotic air with a proportion of common air, and the father

and mother were surprised, when they observed that the hands, which were before "parching hot," soon felt "cold" to the touch; the pulse was rendered 20 beats less in a minute; the child no longer coughed as through a brazen trumpet, the fever seemed smothered, and the formation of the fatal membrane was prevented.

Six quarts of azotic air were inhaled, made by gradually burning of spirits of wine under a bell-glass

XXVIII. PNEUMONIA.

	CIRCUMSTANCES
Case LXVII. Mr Crump, under Dr. Beddoes, cured Vide Beddoes' Considerations, Part I. page 175.	*Communicated by Dr Beddoes.* In the inflammatory stage of catarrh, and all the gradations of disease which connect a common cold with pleurisy, I hope the exhibition of a lowered atmosphere will prove an effectual remedy From several cases I am at present inclined to prefer hydrogen

or azotic air, because they can be so freely and frequently administered. In my letter to Dr. Darwin, I have described the effect of atmospheric air lowered with one-eighth of hydrogen air, and respired for a quarter of an hour, in an inflammation of the chest. The acute pain entirely subsided while the patient was breathing this mixture, and the febrile symptoms disappeared.—I have been eye-witness of another fact of the same kind, since.

XXIX. PHTHISIS.

CIRCUMSTANCES

Case LXVIII. Lieut. —— under Dr. Beddoes', cured. Vide Dr. Beddoes' Considerations, Part IV. page 111.

Letter from Mr. Scott to Dr. Beddoes.

Bombay, May 4, 1796.

SIR,

I have lately met with a case which is a confirmation of your opinion regarding the phthisis pulmonalis, and its method of cure. A lieutenant in the Bombay marine was lately, at Bengal, so ill of a complaint which every body believed to be a consumption, that for a long time he was incapable of doing his duty, and given over as incurable. In this hopeless situation it became necessary to him to proceed to Bombay. During the passage the bilge water of the ship got at some sugar with which she was laden; which, from its decomposition, was supposed to have injured very much the purity of the air. Below decks the air certainly became very impure; which at first induced this gentleman to remain above: but he one day, on going down below, observed that his respiration went on much more easily than on deck. He soon fell into a sound sleep in this new situation; and from that time he remained below in this atmosphere, from which he continued to feel relief. His health afterwards daily improved; and he is at this moment in good health, and doing his duty at sea.

I remain, Sir, &c.

W. SCOTT.

CIRCUMSTANCES.

Case LXIX. Mr. Gregory, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XIII. page 95.

Communicated by Dr. Thornton.

Mr. Gregory, M. P. of Berner's-street, who had been long resident in India, laboured for several months under all the symptoms of phthisis pulmonalis. He expectorated a quantity of thick, opaque, and yellowish matter which sunk in water, had disturbed nights, was greatly wasted, and his breathing was short and interrupted. He took by my order (which was executed by Mr. Seaton, a very ingenious apothecary and able chemist, who lives in Bridge-street, Westminster) from four to six quarts of hydro-azot daily, mixed with twelve of atmospheric air, and at the same time had a mixture of myrrh and bark, with opiates occasionally; and under this treatment the cough was soon diminished, and in six weeks the patient was restored to health, and has continued free from every complaint these eight months; even a cold now passes off without exciting any symptoms of alarm.

Observations by Dr. Thornton.

The hydro-azot is made by burning æther under a tin bell, when the oxygen unites with the hydrogen and forms water, and the residue is azotic air; a species of heavy, inflammable, or hydrogen air, and some æther in the state of vapour, and a small proportion of fixed air. I have myself inhaled ten quarts of this pure, and the pulse has sunk from eighty to seventy beats in a minute, and continued so for a quarter of an hour or more. It is very grateful to the lungs; and I flatter myself, that this new species of air, first employed by me, may prove hereafter a valuable acquisition to the *ars medendi*. As we brace the constitution with tonic medicines, there is danger of local inflammation, which this appears to obviate; or, has the hydro-azot any peculiar healing quality?

The reader is referred to Dr. Beddoes' Considerations, where a great many cases are related, in which the hydrogen, hydrocarbonat, and other mephitic airs and vapours have been employed in pulmonary diseases, &c. but it is from the establishment of the *Pneumatic Institution*, which we have before announced, that we expect the full crop of discoveries in this so interesting a branch of science.

END OF VOL. I.

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